2001 ~ 2002

PHOTOELECTRIC SENSORS

BANNER®

the photoelectric specialist

Banner Headquarters
Minneapolis, MN

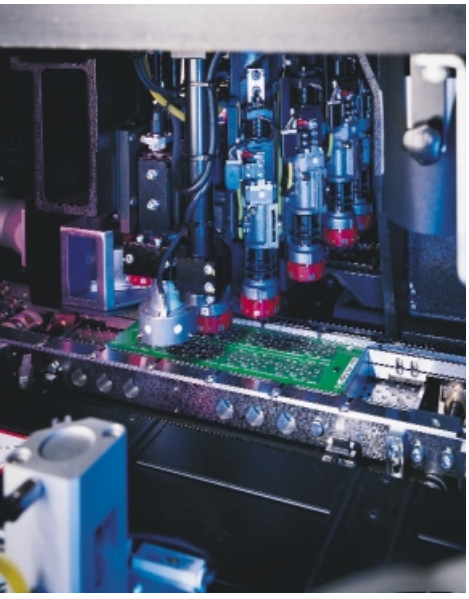
Banner Manufacturing Plant
Minneapolis, MN

Banner Manufacturing Plant
Huron, SD

Banner Manufacturing Plant
Aberdeen, SD

Banner Manufacturing Plant
Fergus Falls, MN

15,000 Different Ways to Solve Your Applications.



With more than 15,000 products, Banner offers the industry's most complete and integrated line of photoelectric and ultrasonic sensors, machine safety products, and measurement/ inspection products—a solution for every possible application. We ship thousands per day; a Banner sensor is installed every 3 ½ seconds! Whatever part or material you need to sense or inspect, Banner has the solution.

Advanced Manufacturing Capabilities.

Automation is the backbone of Banner's world-class manufacturing capabilities. Banner's surface-mount components and extremely fast pick-and-place technology populate boards at speeds of nearly 30,000 components per hour. This is only one reason Banner has the manufacturing capacity to meet market demands and handle any size order. We can typically deliver any of more than 15,000 products in just three days; most can ship within hours!

Industry's Most Preferred Sensors.

More engineers prefer to purchase Banner sensors than any other brand, by a wide margin. Why? Because Banner is the largest, most capable sensor manufacturer, with the broadest line of products and solutions in the world. Banner application engineers can solve more of your applications, with the best field representatives and distributors to back them up.

Sensors for All Industries, Worldwide.

Banner makes sensors for every manufacturing and process industry. Whatever industry you're in and whatever product you manufacture, Banner has the right sensors to automate your plants and to improve your overall efficiency, quality and safety.

⚠ Important Safety Warning...Please Read! ⚠

Sensors described in this catalog do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can result in either an energized or a de-energized output condition.

Never use these products as sensing devices for personnel protection. Their use as safety devices may create an unsafe condition which could lead to serious bodily injury or death.

Only MINI-SCREEN,® MULTI-SCREEN,® MICRO-SCREEN,® MACHINE-GUARD,™ and PERIMETER-GUARD™ Systems, and other systems so designated, are designed to meet OSHA and ANSI machine safety standards for point-of-operation guarding devices. No other Banner sensors or controls are designed to meet these standards, and they must NOT be used as sensing devices for personnel protection. See the Banner Machine Safety Products catalog for information on point-of-operation guarding devices.

BANNER®
the photoelectric specialist

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www.bannerengineering.com • email: sensors@bannerengineering.com

Visit Banner On-Line at
www.bannerengineering.com

- Complete product information for:
  - Photoelectric sensors
  - Measurement and inspection sensors
  - Machine safety products
- Up-to-date "What's New" page.
- Complete descriptions for each product, with links to product data sheets, dimension drawings and AutoCAD .DXF files.
- Product catalogs, specifier's guides, and product brochures available for immediate download or email request.

Buy Banner products online!

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- Facilities and capabilities
- Business units
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Product information:
- Complete product specifications
- Download data sheets and user manuals
- Download product tutorials
- Download AutoCAD drawings

Current "What's New" information:
- New products
- New literature
- Upcoming trade shows
- Company news

Application notes grouped by:
- Product type:
  - Photoelectric sensors
  - Measurement & inspection sensors
  - Machine safety products
- Industry type
- Application type
- Product family

Literature and resource information:
- Product catalogs and specifier's guides
- Product data sheets, manuals, and product software
- Application tutorials and FAQs
- Banner BEAM newsletter
- International product literature

Contact information:
- Find local support, worldwide
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- Request literature
- Purchase products online
- Subscribe to online newsletter

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FIBER OPTICS

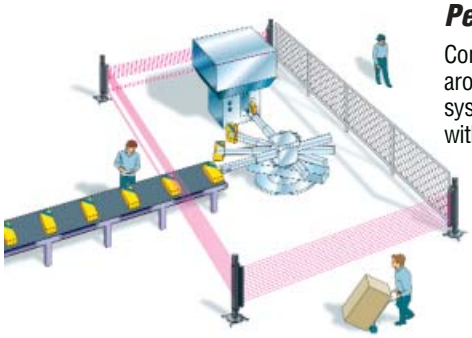
SENSOR ACCESSORIES

SUPPLEMENTAL INFORMATION

Banner also offers Machine Safety Products . . .

Miniature Light Screens

Light screen systems for smaller machinery have big, ultra-bright diagnostic indicators, and a choice of metal box or DIN-rail module controllers. Banner systems are the easiest to set up, using their built-in diagnostic LED indicators.



Perimeter-Guarding Systems

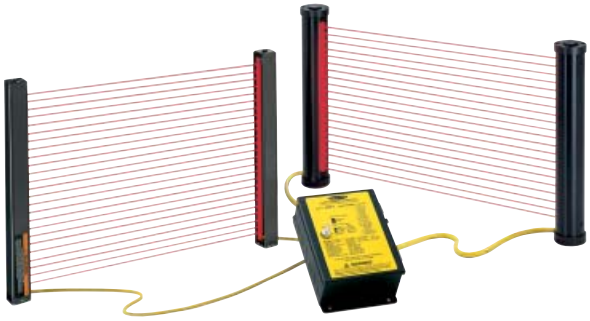
Complete systems monitor the boundary around machines, robots and assembly systems. Control two, three, or four sides with the use of corner mirrors.

Two-Hand-Control Systems

These safety devices require both of the operator's hands to operate two inputs simultaneously to safely start and maintain a normal machine cycle. Redundant design meets EN574 standards.

Safety Interlock Switches

Switches and controls fit all types of guard doors and covers, and feature "positive-opening" contacts as required by international safety standards.



Dual-Light-Screen Systems

Operate two light screens with one controller, saving wiring and panel space and eliminating the cost of additional controllers. Dual systems allow simultaneous guarding of two areas on one machine.

Safety Modules

Banner offers three types of safety modules: two-hand-control modules, emergency stop safety modules, and safety extension modules.

Magnetic Safety Switches

Sealed switches with triple-coded magnets are extremely resistant to defeat, and are tolerant of dirt buildup, liquids, and poor alignment.

EZ-GUARD™

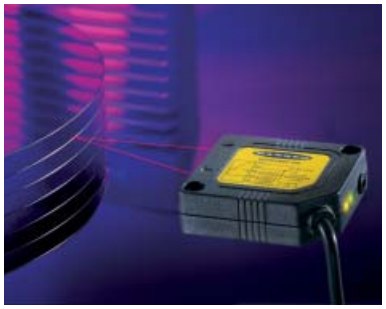
A two-part non-contact safety system for perimeter or access guarding. Easy and economical to install. Models available with 1, 2, 3, or 4 beams.

Fieldbus-Compatible Light Screens

Light screen control modules offer complete system monitoring on DeviceNet™ fieldbus networks for non-safety monitoring of system status. They offer convenience, simplified troubleshooting and use, and low operating costs.

For an overview of Banner Machine Safety Products, see information starting on page 780

AND Precision Measurement & Inspection Systems.



High-Resolution Measurement Light Screens

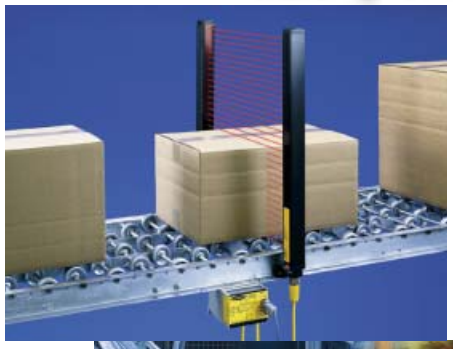
For precise product profiling and on-the-fly sizing, measuring light screens offer true 2.5 mm (0.1") resolution and incredible flexibility, including three scanning modes and eight measurement modes, using Windows® software.

Sensors for Microelectronic Manufacturing

Photoelectric and laser technologies solve difficult applications such as flat finding, wafer mapping, part presence, lead frame hole sensing, IC orientation, pin counting, small parts detection and leak detection. PicoDot® shown has a convergent point size of only 0.25 mm (0.01").

Advanced Inspection Sensors

Camera-based sensors provide advanced vision functions at lower cost than high-end vision systems. Extremely easy to set up and simple to use.



Measuring Light Screens

A-GAGE® Measuring light screens perform advanced measuring applications, including on-the-fly product sizing, object profiling, product inspection, package measurement and web guiding. Choose from several controllers.

Remote Ultrasonic Sensors

Remote ultrasonic sensors for small and/or hard-to-access spaces detect object presence within ±0.5 mm (0.02") with an exceptional sensing repeatability of ±0.15%. Analog versions feature accurate 0.075 to 0.375 mm (0.003" to 0.015") resolution.

LT3 Time-of-Flight Sensor

LT3 sensors can measure the distance to objects up to 3.3 m (10') away using advanced time-of-flight technology. Measurement resolution is 1 mm for white targets. Simple pushbutton set-up allows for fast configuration of analog and discrete outputs. Response speed is adjustable to 1, 10, or 100 ms. For measuring even longer distances, choose a retroreflective model.

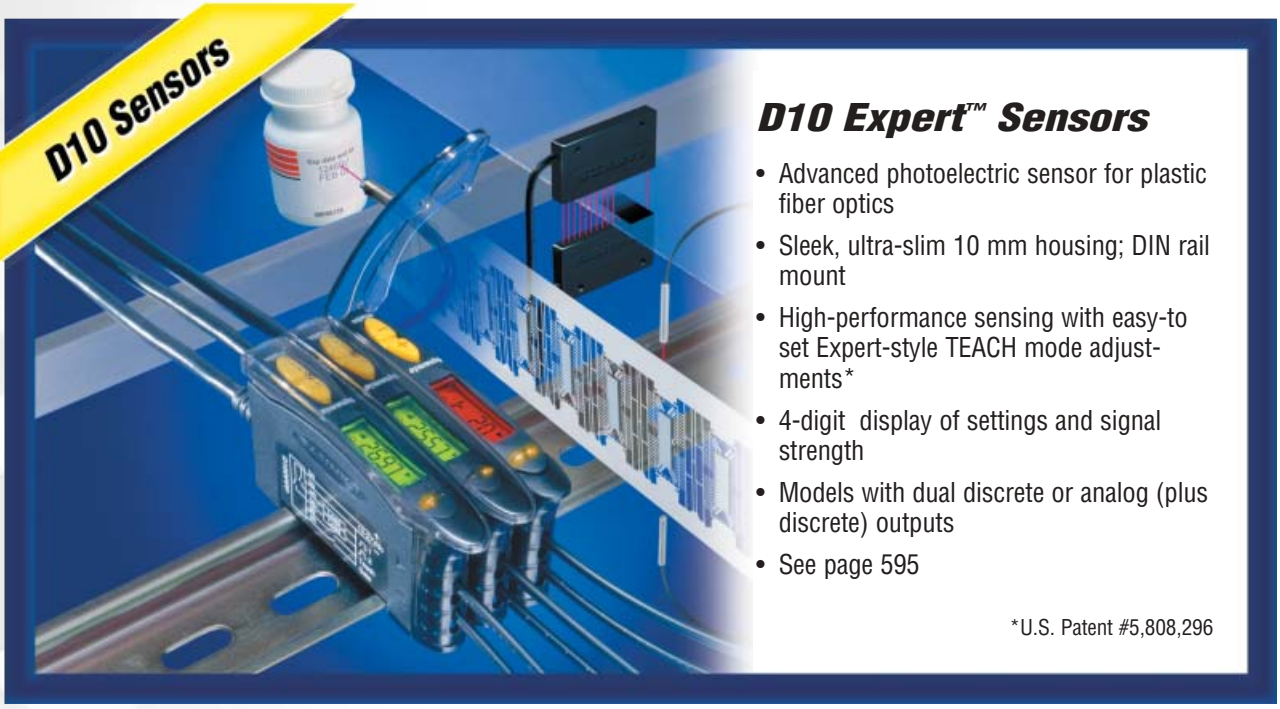
L-GAGE® Laser Measurement Sensors

LG Series sensors are much less expensive and easier to use than others currently available. They feature an outstanding maximum resolution of 3 µm (0.0001").

Ultrasonic Gauging Sensors

Patented U-GAGE® T30U ultrasonic sensors for precise measurement have both switched and analog outputs in one sensor, performing both measurement and on-off switching simultaneously.

For an overview of Banner Measurement & Inspection products, see information starting on page 786



D10 Expert™ Sensors

- Advanced photoelectric sensor for plastic fiber optics
- Sleek, ultra-slim 10 mm housing; DIN rail mount
- High-performance sensing with easy-to set Expert-style TEACH mode adjustments*
- 4-digit display of settings and signal strength
- Models with dual discrete or analog (plus discrete) outputs
- See page 595

*U.S. Patent #5,808,296

WORLD-BEAM™ Sensors

- Innovative universal housing design* fits almost any sensor mounting situation
- Available in six sensing modes:
  - Opposed (through-beam)
  - Retroreflective
  - Convergent beam
  - Diffuse
  - Adjustable-field
  - Plastic fiber optic
- Advanced diagnostics with highly visible status indicators
- Rugged, sealed housing is rated IEC IP67; NEMA 6
- See page 106

*U.S. Design Patent pending

MINI-BEAM®2 Sensors

- A new level of sensor miniaturization: less than 1/3 the size of the original MINI-BEAM
- Available in opposed, retroreflective, diffuse, and convergent sensing modes
- Digital push-button gain adjustment
- Rugged, sealed housing is rated IEC IP67; NEMA 6
- Available with integral cable or pico-style quick-disconnect
- See page 90

VS3 Sensors

- Extremely compact self-contained miniature dc sensors
- Available for opposed and polarized retroreflective mode sensing
- Retroreflective models use coaxial optics to eliminate "blind" area at close range
- Opposed mode range up to 1.2 m
- Choice of integral cable or pico-style quick-disconnect
- See page 70

Label Sensors

C-GAGE®
SLC1 Label Sensors

- Reliably detects the presence of most types of labels on web backing, including clear labels on opaque backing
- No user adjustments - Adaptive Digital Logic (ADL)* provides revolutionary self-learning capability
- Continuous automatic internal drift compensation for sensing threshold
- Perfect for label registering and label counting applications
- See page 322

*U.S. Patent pending

Slot Sensors

SL10 Slot Sensors

- One-piece opposed mode sensors provide easy installation, requiring no sensor alignment
- Ideal for gear tooth counting, edge detection, and label detection
- High-power visible red sensing beam
- SL10 features 4-turn, clutched sensitivity adjustment
- SLE10 *Expert™* models have single-button TEACH mode sensitivity setting, and can also be programmed remotely
- See page 318

WORLD-BEAM™ Adjustable-Field Sensors

- Multi-turn adjustment of sensing field cutoff point from 20 to 100 mm
- Innovative universal housing design fits almost any sensor mounting situation
- Advanced diagnostics with highly visible status indicators
- Rugged, sealed housing is rated IEC IP67; NEMA 6
- Available with integral cable or pico-style pigtail quick-disconnect
- See page 109

Q60 Adjustable-Field Sensors

- Long-range adjustable-field sensor
- Two-turn logarithmic adjustment of sensing field cutoff point from 0.2 to 2 m; easy to set at long range
- Rolling pointer indicates relative cutoff point setting
- Easy push-button or remote programming of light/dark operate and output timing
- Available with integral cable or rotating euro-style quick-disconnect fitting
- Powered by 10 to 30V dc; 24 to 250V ac/dc universal voltage models available Summer of 2001
- See page 267

R55 Fiber Optic Sensors

- Color registration mark sensors for use with fiber optics; models available for glass or plastic fiber assemblies
- Outstanding color contrast sensitivity: detects 16 levels of gray scale
- Easy-to-use push-button or remote TEACH mode settings; non-volatile memory
- Bipolar (NPN/PNP) outputs; fast, 50 microsecond response
- Choose from five beam colors: infrared, plus visible red, blue, green, and white
- See page 306

R55 Expert™ Sensors

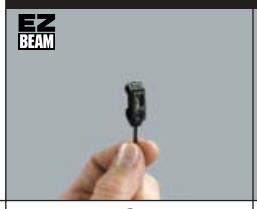
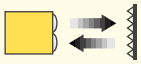
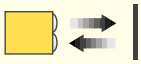
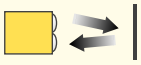
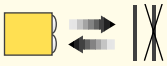
- Color registration mark sensors with easy push-button or remote TEACH mode settings; non-volatile memory
- Outstanding color contrast sensitivity: detects 16 levels of gray scale
- Fast, 50 microsecond response; bipolar discrete outputs plus one analog output
- LED light bar clearly displays signal strength
- Rugged zinc alloy housing with high-quality acrylic lens; rated IEC IP67; NEMA 6
- See page 298

L-GAGE® Q50 Linear Displacement Sensors

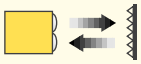
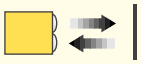
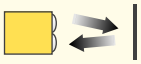
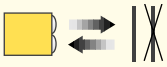
- LED-based linear displacement sensor; range up to 400 mm
- Fast, easy-to-use push-button or remote TEACH mode programming of sensing window size and position
- Analog and discrete output models available
- Rugged construction rated IEC IP67; NEMA 6P
- Available with integral cable or rotating euro-style quick-disconnect fitting
- See page 261

Ruggedized PicoDot® Sensors

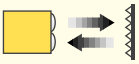
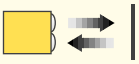
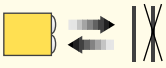
- Popular PicoDot laser sensors were originally designed to minimize weight, for use on robotic end effectors; they are now available in a ruggedized housing for use in more challenging sensing environments
- Differences in housing design include:
  - Tough ABS/polycarbonate alloy housing with thicker walls
  - Welded lens and indicator windows
  - O-ring sealed cable entrance and gain adjustment
- Rated IEC IP67; NEMA 6; suitable for many food processing applications
- See page 254

Photoelectric Sensors EZ-BEAM sensors require no adjustment	Photoelectric Sensors				
					
Series	**VS1**	**VS2**	**VS3**	**Q08**	
Catalog Page	**60**	**64**	**70**	**74**	
Opposed mode 		1.2 m	1.2 m	0.5 m	
Retroreflective modes 			0.25 m		
Diffuse proximity modes 				60 mm	
Convergent proximity mode 	10 or 20 mm focus	15 or 30 mm focus			
Fixed-/Adjustable-field proximity mode 					
Fiber optic modes 					
Dimensions (h x w x d)	26 x 8.3 x 12 mm	25 x 12 x 4.3 mm	26 x 9 x 16 mm	32 x 20 x 8 mm	
Housing material	ABS	ABS	ABS	Zinc alloy	
Protection rating	IP67; NEMA 6	IP67; NEMA 6	IP67; NEMA 6	IP67; NEMA 6	
Operating temperature	-20° to +55°C	-20° to +55°C	-20° to +55°C	0° to +50°C	
Power supply: V dc	12 to 24	12 to 24	10 to 30	10 to 30	
V ac (50/60 Hz)					
V ac/dc					
Output: NPN (sinking)	50 mA	50 mA	50 mA	150 mA	
PNP (sourcing)	50 mA	50 mA	50 mA	150 mA	
NPN + PNP					
SCR or FET					
E/M relay					
Analog					
Output timing option					
Connections: Cable	✓	✓	✓	✓	
Quick-disconnect (QD)	✓	✓	✓	✓	
Wiring chamber					
I.S./NAMUR models					
Low-contrast models					
Self-diagnostics + alarm					

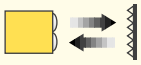
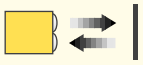
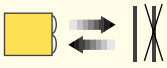
Photoelectric Sensors					
					
	Q10	**Q14**	**MINI-BEAM®2**	**Q23 & QH23**	**WORLD-BEAM™**
	80	**84**	**90**	**96**	**106**
	1.8 m	1.8 m	4 m	8 m	20 m (long range) 3 m (short range)
			2 m (non-polarized) 1 m (polarized)	2 m (polarized)	6.5 m (non-polarized) 3.5 m (polarized)
	0.5 m		200 mm (diffuse) 50 mm (divergent)	800 mm (long range) 200 mm (short range)	450 mm (diffuse) 100 mm (divergent)
			10 mm or 20 mm focus	50 mm focus	16 mm or 43 mm focus
					20 to 100 mm
				Plastic	Plastic
	35 x 20 x 10 mm	31 x 7.5 x 14 mm	20 x 8 x 37 mm	34 x 12 x 23 mm	35 x 15 x 31 mm
	ABS	ABS	ABS	ABS	ABS
	IP67; NEMA 6	IP54; NEMA 4	IP67; NEMA 6	IP67; NEMA 6	IP67; NEMA 6
	-40° to +70°C	-20° to +55°C	-20° to +55°C	-20° to +55°C	-20° to +70°C
	10 to 30	10 to 30	10 to 30	10 to 30	10 to 30
	150 mA	150 mA	150 mA	150 mA	100 mA
	150 mA	150 mA	150 mA	150 mA	100 mA
	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓
				✓	

Photoelectric Sensors EZ-BEAM sensors require no adjustment	**Photoelectric Sensors**				
					
Series	**MINI-BEAM®**	**ECONO-BEAM®**	**S12**	**S18 & M18**	
Catalog Page	**115**	**159**	**176**	**178 & 186**	
Opposed mode 	30 m (long range) 3 m (short range)	1.8 m	15 m	20 m	
Retroreflective modes 	4.5 m (non-polarized) 2 m (polarized)	4.5 m (non-polarized)		2 m (polarized) 2 m (non-polarized)	
Diffuse proximity modes 	0.38 m (long range) 0.13 m (short range)	0.20 m (long range) 0.08 m (short range)		0.3 m (long range) 0.1 m (short range)	
Convergent proximity mode 	16 or 43 mm focus	12 or 16 mm focus			
Fixed-/Adjustable-field proximity mode 				25, 50 or 100 mm	
Fiber optic modes 	Glass or plastic	Glass or plastic			
Dimensions (h x w x d)	(see specs)	38 x 32 x 30 mm	M12 x 1 x 64 mm	M18 x 1 x 59 mm	
Housing material	PBT polyester	PBT or LEXAN®	PBT polyester	S18: PBT; M18: stainless steel	
Protection rating	IP67; NEMA 4X	IP66; NEMA 4X	IP67; NEMA 6P	IP67; NEMA 6P	
Operating temperature	-20° to +70°C	0° to +50°C	-40° to +70°C	-40° to +70°C	
Power supply: V dc	10 to 30 or 5 to 15 (NAMUR)	10 to 30	10 to 30	10 to 30	
V ac (50/60 Hz)	24 to 240	105 to 130		20 to 250	
V ac/dc	24 to 240				
Output: NPN (sinking)			150 mA	150 mA	
PNP (sourcing)			150 mA	150 mA	
NPN + PNP	Bipolar, 150 mA	Bipolar, 150 mA			
SCR or FET	300 mA	300 mA		300 mA	
E/M relay	3 A				
Analog					
Output timing option					
Connections: Cable	✓	✓	✓	✓	
Quick-disconnect (QD)	✓		✓	✓	
Wiring chamber					
I.S./NAMUR models	✓ (MIAD9)				
Low-contrast models	✓				
Self-diagnostics + alarm	✓ (Expert)		✓	✓	

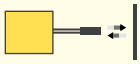
Photoelectric Sensors					
					
	S30	**Q25**	**Q40**	**T18**	**T30**
	190	**194**	**196**	**200**	**206**
	60 m	20 m	60 m	20 m	60 m
	6 m (polarized)	2 m (polarized)	6 m (polarized)	2 m (polarized) 2 m (non-polarized)	6 m (polarized)
				0.5 m (dc models) 0.3 m (ac models)	
	200, 400, or 600 mm	25, 50 or 100 mm	200, 400, or 600 mm	25, 50 or 100 mm	200, 400, or 600 mm
	M30 x 1.5 x 69 mm	50 x 25 x 30 mm	70 x 40 x 46 mm	42 x 30 x 30 mm	52 x 40 x 45 mm
	PBT polyester	PBT polyester	PBT polyester	PBT polyester	PBT polyester
	IP67; NEMA 6P	IP67; NEMA 6P	IP67; NEMA 6P	IP67; NEMA 6P	IP67; NEMA 6P
	-40° to +70°C	-40° to +70°C	-40° to +70°C	-40° to +70°C	-40° to +70°C
	10 to 30	10 to 30	10 to 30	10 to 30	10 to 30
	20 to 250	20 to 250	20 to 250	20 to 250	20 to 250
	150 mA	150 mA	150 mA	150 mA	150 mA
	150 mA	150 mA	150 mA	150 mA	150 mA
	300 mA	300 mA	300 mA	300 mA	300 mA
	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓

Photoelectric Sensors EZ-BEAM sensors require no adjustment	**Photoelectric Sensors**				
					
Series	**QM42**	**PicoDot®**	**Q50**	**Q60**	
Catalog Page	**239**	**253**	**261**	**267**	
Opposed mode 	10 m				
Retroreflective modes 	3 m (polarized)	40 m			
Diffuse proximity modes 	0.4 m (short range) 6 m (long range)				
Convergent proximity mode 		102 mm or 203 mm focus			
Fixed-/Adjustable-field proximity mode 	Adjustable field: Max. 150 or 400 mm Fixed-field: 0.5, 0.75, 1, 1.5, or 2 m		Adjustable field: Max. 300 or 400 mm	Adjustable field: Max. 2 m	
Fiber optic modes 	Plastic				
Dimensions (h x w x d)	42 x 13 x 42 mm	41 x 13 x 46 mm	60 x 20 x 50 mm	75 x 25 x 60 mm	
Housing material	Zinc alloy	ABS	ABS/Polycarbonate	ABS/Polycarbonate	
Protection rating	IP67; NEMA 6P	IP54; NEMA 3	IP67; NEMA 6P	IP67; NEMA 6	
Operating temperature	-20° to +70°C	-10° to +45°C	-10° to +55°C	-20° to +55°C	
Power supply: V dc	10 to 30	10 to 30	15 to 30	10 to 30	
V ac (50/60 Hz)					
V ac/dc					
Output: NPN (sinking)	100 mA	150 mA			
PNP (sourcing)	100 mA	150 mA			
NPN + PNP				150 mA	
SCR or FET					
E/M relay					
Analog			4 to 20 mA or 0 to 10V sourcing		
Output timing option				✓	
Connections: Cable	✓	✓	✓	✓	
Quick-disconnect (QD)	✓	✓	✓	✓	
Wiring chamber					
I.S./NAMUR models					
Low-contrast models					
Self-diagnostics + alarm	✓				

Photoelectric Sensors						
						
	SM512	**SM30**	**R55**	**SL Series**	**VALU-BEAM®**	**Q85**
	273	**283**	**297**	**313**	**327**	**371**
	30 m (long range) 8 m (short range)	60 m (EZ-BEAM) 200 m (standard) 140 m (SMI30)		10 mm (SL10) 30 mm (SL30)	60 m (long range) 3 m (short range)	23 m
	4.5 m (infrared) 2 m (visible red)				9 m (non-polarized) 4.5 m (polarized)	4.5 m (polarized)
	0.38 m (long range) 0.20 m (short range) 0.15 m (divergent)				0.76 m (long range) 0.38 m (short range)	1.0 m (long range) 0.25 m (short range)
	32 or 4.3 mm		10 mm		38 mm focus	
	Glass		Glass or plastic R55F (see page 306)		Glass or plastic	
	64 x 13 x 80 mm	M30 x 1.5 x 102 mm	92 x 30 x 56 mm	72 x 52 x 19 mm	64 x 37 x 36 mm	67 x 25 x 85 mm
	Zinc alloy	PBT or stainless steel	Zinc alloy	ABS	PBT polyester	ABS
	IP66; NEMA 4	IP67; NEMA 6P	IP67; NEMA 6	IP67; NEMA 6	IP66; NEMA 4X	IP67; NEMA 6P
	-40° to +70°C	-40° to +70°C	-10° to +55°C	-40° to +70°C	(see specs)	-25° to +55°C
	10 to 30 or 12 to 18	10 to 30	10 to 30	10 to 30	(see specs)	10 to 48
		24 to 240 (standard) 20 to 250 (EZ-BEAM)			(see specs)	
					(see specs)	12 to 240 (ss output) 24 to 240 (e/m relay)
	250 mA	150 mA (EZ-BEAM)				
		150 mA (EZ-BEAM)				
		Bi-Modal; 250 mA (std)	Bipolar, 150 mA	Bipolar, 150 mA	Bipolar, 250 mA	Bipolar, 150 mA
		500 mA; 300 mA (EZ)			750 mA	300 mA
					5 A	3 A
			0 to 10 mA			
			✓			✓
	✓	✓	✓	✓	✓	
		✓	✓	✓	✓	w/optional accessory
						✓
		✓ (SMI30)			✓ (SMI912)	
			✓	✓		
		✓ (EZ-BEAM)				

Photoelectric Sensors	Photoelectric Sensors				
					
Series	**Q45**	**OMNI-BEAM™**	**MAXI-BEAM®**	**MULTI-BEAM®**	
Catalog Page	**379**	**425**	**455**	**475**	
Opposed mode 	60 m	45 m	90 m (long range) 4.5 m (short range)	Several ranges to 200 m	
Retroreflective modes 	70 m (laser) 9 m (non-polarized) 6 m (polarized)	9 m (non-polarized) 4.5 m (polarized)	9 m (non-polarized) 4.5 m (polarized)	23 m (infrared) 9 m (non-polarized) 4.5 m (polarized)	
Diffuse proximity modes 	3 m (long range) 1.8 m (medium range) 0.5 m (short range)	1.8 m (long range) 0.3 m (short range)	1.5 m (long range) 0.76 m (short range)	2 m (long range) 0.6 m (medium range) 0.3 m (short range)	
Convergent proximity mode 	38 or 100 mm focus	38 mm focus	38 mm focus	38, 100, or 150 mm focus	
Fixed-/Adjustable-field proximity mode 			50 or 100 mm		
Fiber optic modes 	Glass or plastic	Glass or plastic	Glass or plastic	Glass	
Dimensions (h x w x d)	88 x 45 x 55 mm	76 x 45 x 55 mm	114 x 40 x 48 mm	114 x 40 x 53 mm	
Housing material	PBT polyester	PBT polyester	PBT polyester	PBT polyester	
Protection rating	IP67; NEMA 6P	IP66; NEMA 4	IP66; NEMA 4	IP54; NEMA 3	
Operating temperature	-40° to +70°C	-40° to +70°C	-40° to +70°C	-40° to +70°C	
Power supply: V dc	10 to 30 or 5 to 15 (NAMUR)	10 to 30	10 to 30	10 to 30; or 48	
V ac (50/60 Hz)	90 to 250	105 to 130 or 210 to 250	105 to 130 or 210 to 250	12, 24; 105 to 130; 210 to 250	
V ac/dc	12 to 250V dc or 24 to 250V ac		12 to 30V dc or 12 to 250V ac		
Output: NPN (sinking)				250 mA	
PNP (sourcing)				250 mA	
NPN + PNP	Bipolar, 250 mA	Bi-Modal™, 100 mA	Bipolar, 250 mA		
SCR or FET	300 mA	500 mA	750 mA	750 mA	
E/M relay	5 A		5 A	5 A	
Analog		0 to 10V sourcing			
Output timing option	✓	✓	✓	✓	
Connections: Cable	✓	✓			
Quick-disconnect (QD)	✓	✓	w/optional accessory	w/optional accessory	
Wiring chamber			✓	✓	
I.S./NAMUR models	✓ (Q45AD9)				
Low-contrast models		✓			
Self-diagnostics + alarm		✓			

Part-Sensing Light Screens		
		
	PVA	**LS Series**
	520	**526**
	2 m	**LS4:** 2.3 m **LS10:** 1.2 m **LS10SR:** 0.2 m
	Height x 30 x 15 mm	116 x 40 x 49 mm
	Black anodized aluminum	PBT polyester
	IP62; NEMA 2	IP54; NEMA 12
	0° to +50°C	0° to +50°C
	12 to 30	12 to 30
	150 mA	125 mA
	150 mA	125 mA
	✓	✓
	✓	✓

Fiber Optic Sensors (Fiber optic cables are purchased separately)	Fiber Optic Sensors			
				
Series	**D10**	**D11**	**D12**	**PC44**
Catalog Page	**595**	**603**	**617**	**635**
Opposed Mode Fiber Optics 	Plastic	Plastic	Plastic & Glass	Plastic
Diffuse Mode Fiber Optics 	Plastic	Plastic	Plastic & Glass	Plastic
Sensor Dimensions (h x w x d)	36 x 10 x 68 mm	35 x 11 x 64 mm	30 x 12 x 70 mm	22 x 15 x 43 mm
Sensor Housing material	ABS	ABS	ABS	Polypropylene
Sensor Protection rating	IP50; NEMA 1	IP54; NEMA 2	IP66; NEMA 4	IP54; NEMA 2
Sensor Operating temperature*	-20° to +55°C	-20° to +55°C	-20° to +70°C	-20° to +50°C
Power supply: V dc	12 to 24 (discrete) 15 to 24 (analog)	10 to 30	10 to 30	10 to 30
Output: NPN (sinking)	150 mA	150 mA	150 mA	100 mA
PNP (sourcing)	150 mA	150 mA	150 mA	100 mA
Analog	0 to 10V dc or 4 to 20 mA			
Connections: Cable	✓	✓	✓	
Quick-disconnect (QD)	✓	✓	✓	
Printed circuit board				✓
Teach-mode programming	✓	✓ (Expert Series)	✓ (Expert Series)	
Low-contrast models	✓	✓ (Expert Series)	✓ (AC-coupled & Expert Series)	
Self-diagnostics + alarm		✓ (Except Expert Series)	✓ (Except AC-coupled Series)	✓

* Operating temperature range for plastic fiber optic assemblies is typically -30°C to +70°C, and -140° to +250°C for metal-sheathed glass fiber optic assemblies. See the fiber optics section (beginning on p. 639) for specific fiber optic temperature information.

An Introduction to Sensing Concepts and Terminology

Introduction

Like nearly any other technology, photoelectric and ultrasonic sensing have their own “buzz words”; this article explains many of them. Some terms are not universal, and a few definitions have developed several names, often due to inconsistent use of sensing terminology among sensor manufacturers.

For those familiar with sensing, this article provides a quick reference. A glossary of sensing terminology is located at the back of this catalog.

Photoelectric Sensor

A photoelectric sensor is an electrical device that responds to a change in the intensity of light falling upon it. Early photoelectric devices used for industrial presence- and absence-sensing applications were small metal barrels, with a collimating lens on one end to focus the beam toward the receiver, and a cable exiting the opposite end which connected the device to an external vacuum tube amplifier (see Figure 1). A small incandescent bulb, protected inside a matching metal barrel, provided the opposing light source. These small, rugged incandescent sensors were the forerunners of today's industrial photoelectric sensors.

Figure 1. Early photoelectric sensors used an incandescent light bulb; advanced technology has resulted in ever-smaller LED-based sensors

LED (Light-Emitting Diode)

Light-emitting diodes (LEDs) first appeared in the 1960s, and are now seen daily as status indicators on many electrical and electronic appliances. An LED is a solid-state semiconductor, similar electrically to a diode, except that it emits a small amount of light when current flows forward through it.

Because they are solid state, LEDs can outlast the useful life of a sensor. Therefore, LED sensors can be totally encapsulated and sealed — making them smaller, yet more reliable than their incandescent counterparts. Unlike incandescent lights, LEDs withstand vibration and shock, and have no filaments to sag. The down side: LEDs produce only a fraction of the light generated by an incandescent bulb of the same size. (Laser diodes are an exception to this, however. Similar to LEDs, laser diodes can produce many times the light intensity and sensing range.)

LEDs can emit infrared light, which is invisible to the human eye, or visible green, yellow, red, blue, blue-green, or white light (see Figure 2). The most efficient of the LED light generators, only infrared LEDs were used in photoelectric sensors until 1975. While ideal for security detection and film processing applications, this invisible light initially was poorly received by those accustomed to visually aligning and checking incandescent emitters.

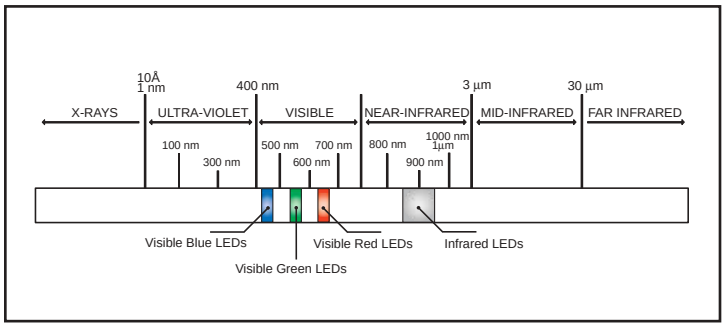


Figure 2. The light spectrum

Phototransistors

As the 1960s ushered in the silicon era, photojunction devices (photodiodes, phototransistors, and photodarlingtons) were introduced. Of these, the phototransistor has prevailed as the most widely used for industrial photoelectric sensing (see Figure 3), offering the best trade off between light sensitivity and response speed.

Figure 3. A typical photocell (left) and a phototransistor (right)

Photocells are used when high sensitivity to visible wavelengths is required, as in some color-registration or ambient-light-detection applications. Photodiodes are useful when either extremely fast response or linear response over widely varying light levels is required.

Modulated LED Sensors

By 1970, LEDs were discovered to have a benefit much more profound than their long life. Unlike incandescent bulbs, LEDs can be turned on and off (modulated) at extremely high speeds — a frequency typically measured in kilohertz (see Figure 4). When a phototransistor receiver amplifier is modulated, it can be "tuned" to the emitter's modulation frequency, and amplify only those light signals that pulse at that frequency.

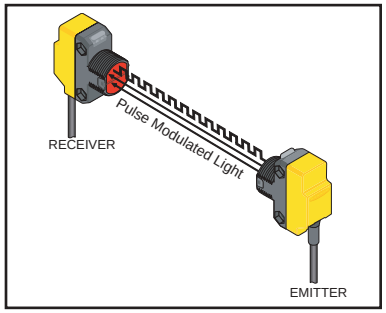


Figure 4. A modulated (pulsed) light source

Modulation can be compared to the transmission and reception of a radio wave. A radio receiver tuned to one station (frequency) ignores the presence of other radio signals. The modulated LED emitter is functionally similar to the radio transmitter, and the tuned photoelectric receiver corresponds to the radio receiver.

It is a common misconception that because an infrared LED system is invisible, it must be powerful. A modulated photoelectric sensor's apparent high power has little to do with the LED's wavelength. An LED emits only a small amount of light energy; the modulation accounts for its power. A non-modulated sensor is powerful only if its receiver can "see" only the light from its emitter, achieved using long-focal-length lenses and/or mechanical shielding. In contrast, a modulated receiver ignores ambient light, responding only to its own — or similarly modulated — light sources.

Non-modulated sensors are still used to sense ambient light or large amounts of infrared radiation, such as red-hot bottles emerging from a furnace — applications that would saturate and "confuse" other sensors. If a material emits more light than the surrounding light level, it may be detected reliably by an ambient light receiver (see Figure 6). Ambient light receivers are also used for outdoor lighting control.

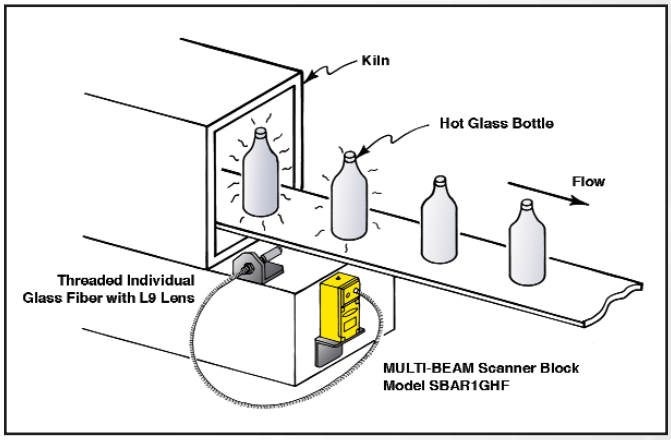


Figure 6. An ambient light receiver senses infrared energy radiated from red-hot glass or metal

Modulated sensors are not totally immune to ambient light, however: extremely bright lights pose a problem. For example, no modulated photoelectric receiver can function normally when pointed directly into sunlight. Anyone who has focused sunlight through a magnifying glass onto a piece of paper knows that enough energy can easily be focused to light the paper on fire. Substitute the magnifying glass with a sensor lens and the paper with a phototransistor, and it becomes easy to understand why a receiver shuts down when pointed directly into the sun. This is ambient light saturation.

Modulated LEDs revolutionized photoelectric sensor design. Sensing ranges increased, and beam angles widened. Users of modulated devices gradually began to trust this dependable, easy-to-align light beam. By 1980, non-modulated photoelectric sensors were nearly just a memory. New automated processes could not tolerate the interruptions caused by the incandescent bulb burnout common in non-modulated systems.

Infrared LEDs are the most efficient, and also the best spectral match to phototransistors (see Figure 7). However, photoelectric sensors used to detect color differences (as in color registration mark sensing) require a

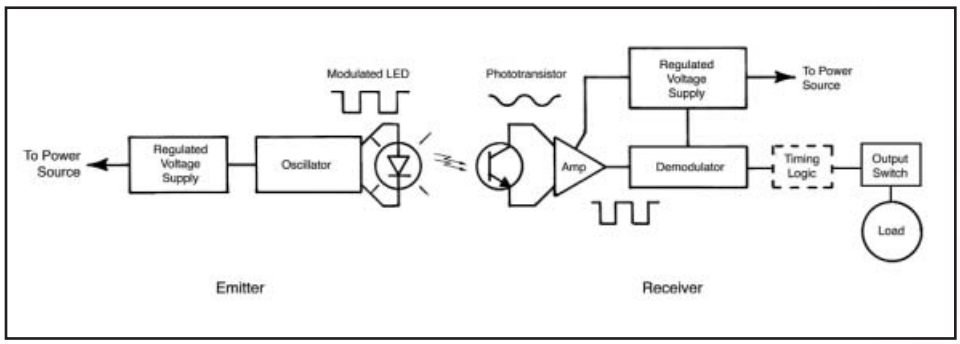


Figure 5. A modulated photoelectric control

visible light source. As a result, color sensors continued to use photocell receivers and incandescent lamps until more efficient visible LEDs were developed. Today, most color registration sensors are modulated, with visible-beam LED emitters in a variety of colors.

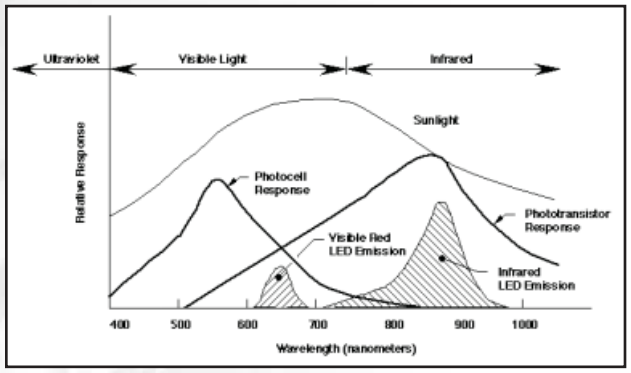


Figure 7. Comparison of spectral response: photocell vs. phototransistor

Modulated sensors usually sacrifice response speed for sensing distance. Because distance is often the dominant sensing application criteria, non-modulated emitter use continued for sensing small parts or fast-moving targets, applications where response speed was critical. However, today's very-high-speed modulated sensors now offer respectable ranges and satisfy most response requirements.

Ultrasonic Sensors

Ultrasonic sensors emit and receive sound at frequencies above the range of human hearing (about 20 kHz). They sense objects by measuring the time it takes to reflect the ultrasound waves from the object's surface and back to the receiver transducer, or by detecting an object's presence when it interrupts the transmission of sound from the emitter to an opposed receiver. Unlike photoelectric sensing, which is based on an object's opacity or reflectivity to light, ultrasonic sensing depends upon an object's density — its ability to reflect or block sound. This makes ultrasonic sensing practical for applications unsuited to photoelectric methods. See Figure 8.

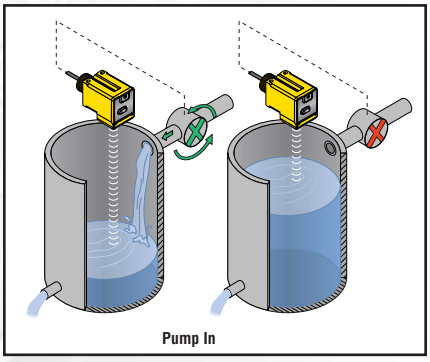


Figure 8. Ultrasonic proximity sensors measure distance by "bouncing" a sound wave to a target surface and back to the sensor

Self-Contained Photoelectric Sensors

Photoelectric sensors are divided into three functional categories: self-contained, remote and fiber optic. Self-contained photoelectric sensors contain the optics along with the electronics; they require only a power source. The sensor performs its own modulation, demodulation, amplification, and output switching. Some self-contained sensors provide such options as built-in control timers or counters. As technology progresses, self-contained photoelectric sensors have become increasingly smaller (see Figure 9).

Figure 9. New design technology has produced self-contained sensors that can function in the smallest areas

Remote Photoelectric Sensors

Remote photoelectric sensors contain only the optical components of a sensor. The circuitry for power input, amplification, and output switching are located elsewhere, typically in a control panel.

Because they contain no circuitry, remote sensors are usually smaller and more tolerant of hostile sensing environments than self-contained sensors.

Figure 10. Remote sensors

Fiber Optics

When space is too restricted or the environment too hostile even for remote sensors, fiber optics (transparent strands of glass or plastic) may be used. Fiber optic "light pipes," used with either remote or self-contained sensors, are passive mechanical sensing components. They have no electrical circuitry and no moving parts, and can safely pipe light into and out of hostile environments.

Moreover, they are immune to all forms of electrical "noise," and can isolate a sensor's electronics from electrical interference.

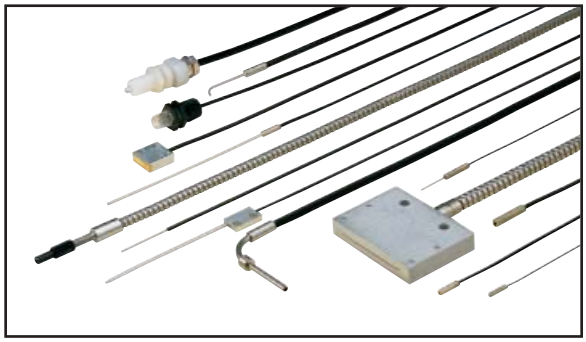


Figure 11. Glass and plastic optical fibers take many forms

An optical fiber has a glass or plastic core, surrounded by a layer of cladding material. The cladding is less dense than the core, and consequently has a lower index of refraction. A light ray hitting the boundary between these two materials (provided that the angle of incidence is within certain limits – "ø"; see Figure 12) will be reflected totally, sending all of the light through the fiber, according to the optical principle of total internal reflection.

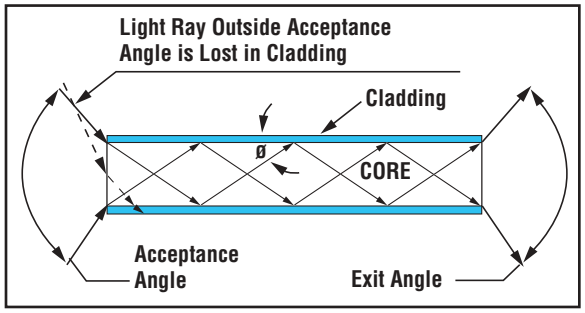


Figure 12. Acceptance angle and exit angle of a single fiber

Figure 12 illustrates two light rays (within the angle of acceptance) that reflect repeatedly along the fiber's length and exit the opposite end at approximately the entry angle. Another light ray (outside the angle of acceptance) is lost into the cladding. The acceptance angle is slightly larger than twice ø, because the rays bend slightly as they pass from the air into the denser fiber material. The principle of total internal reflection applies, regardless of whether the fiber is straight or bent (up to a minimum bend radius). Most fiber optic cables are flexible and route easily through tight areas.

Glass Fiber Optics

Glass fiber optic assemblies are a bundle of very small (usually about 50 micron diameter) glass fiber strands. A typical cable contains several hundred individually cladded glass fibers, protected by an outer sheathing (often flexible armored cable).

The cable's end tip, available in many sizes and designs, is partially filled with rigid clear epoxy. The sensing face is optically polished so that the end of each fiber is perfectly flat. Care taken in the polishing process dramatically improves the light-coupling efficiency of the fiber bundle (see Figure 13).

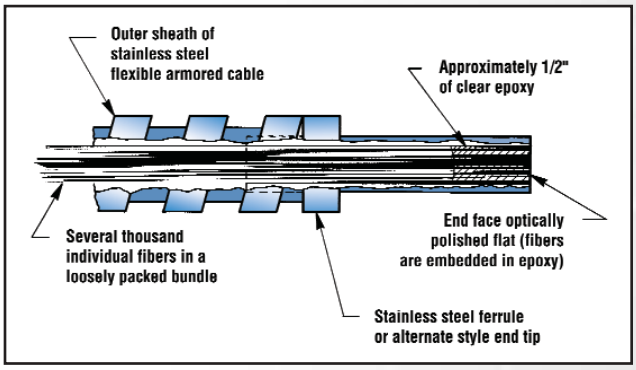


Figure 13. Construction of a glass optical fiber bundle

Glass fiber optic bundles may be coherent or randomized. Coherent-bundle fiber optic assemblies are used in medical instruments and borescopes; each fiber is carefully positioned from one end to the other – an image at one end is clear at the opposite end. Because they are expensive to manufacture and most fiber optic sensing applications do not require such a clear image, most glass fiber optic assemblies used for sensing have randomized bundles with randomly positioned fiber ends, which are much less costly. The resulting "image" is simply a quantity of light.

The outer sheath is usually stainless steel flexible conduit, but also may be PVC or other flexible plastic tubing. Even when a non-armored outer covering is used, a protective steel coil is usually included under the sheath to protect the fibers. Special assemblies can be created for a specific space or sensing environment fairly easily; the bundle may be shaped at the sensing end to "match" the profile of the object to be sensed (Figure 14) or have special armoring.

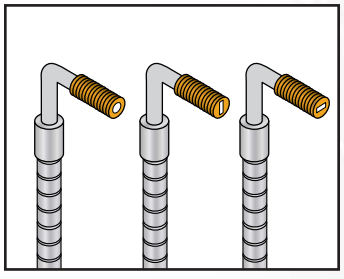


Figure 14. The bundle may be shaped at the sensing end to match the target object's profile

Glass fiber optic assemblies are very rugged and perform reliably in extreme temperatures and amid harsh chemicals. They work well with all visible and infrared light sources. Their most common problem is breakage

of the strands resulting from sharp bending or continued flexing, as on reciprocating mechanisms. For such uses, plastic fiber assemblies are recommended.

Plastic Fiber Optics

Plastic fiber optics are single strands of fiber optic material (typically 0.25 to 1.5 mm diameter), usually with a PVC coating. They can be routed into extremely tight areas and bend to a tight radius.

Most plastic fiber optic assemblies are terminated at the sensing end with a probe and/or a threaded mounting tip. The opposite end is unterminated, to be easily cut to length by the user and installed into the sensor. Banner plastic fibers are shipped with a cutting device for this purpose.

Unlike glass fibers, plastic fibers survive repeated flexing; pre-coiled plastic fiber assemblies are available for mounting on reciprocating mechanisms. However, plastic absorbs certain light wavelengths, including light from most infrared LEDs (see Figure 16). Consequently, plastic fiber optics require a visible light source. Compared with glass, plastic fibers are more sensitive to temperature extremes, chemicals and solvents.

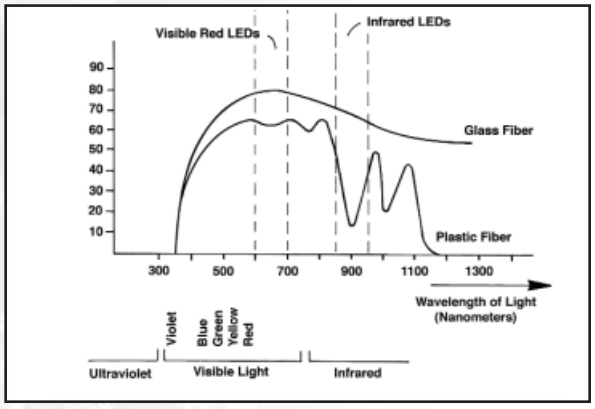


Figure 15. Spectral transmission efficiency of glass and plastic optical fibers

Individual and Bifurcated Fiber Optics

Glass and plastic fiber optic assemblies may be either “individual” or “bifurcated” (Figure 16). Individual fibers guide light either from an emitter to a sensing location, or from the sensing location back to a receiver. Bifurcated fibers have two distinct fiber branches to conduct both emitted and received light, allowing a sensor to both illuminate and view an object through one fiber optic assembly. Light from one branch reflects off an object in front of the fiber’s tip, and back to the receiver through the other branch.

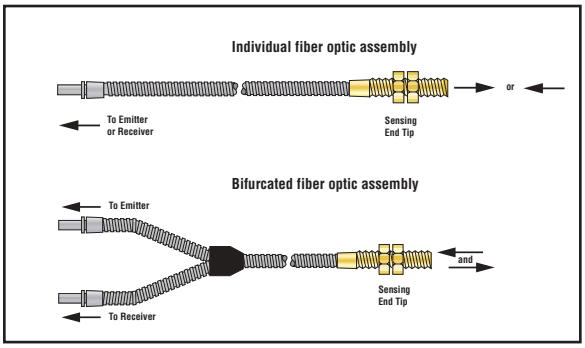


Figure 16. Individual and bifurcated fiber optic assemblies

Emitter and receiver fibers in a bifurcated glass fiber optic assembly usually are randomly mixed in the sensing end tip. Bifurcated plastic fiber strands are joined side-by-side along the cable’s length, in effect, two individual fibers joined at their sensing ends.

Special Uses for Fiber Optics

Because they resist harsh environments and electrical noise, fibers can solve some tricky applications, for example: vacuum feedthrough fiber optic assemblies (VFTs) for vacuum environments and volatile environments. In both cases, specially made fibers inside the hostile environment are routed through a flange to couple with a photoelectric sensor on the outside. Fibers and feedthrough flanges are available in various sizes and designs; see Figure 17. Intrinsically safe sensors, such as NAMUR models, also are designed for use in hostile or explosive environments.

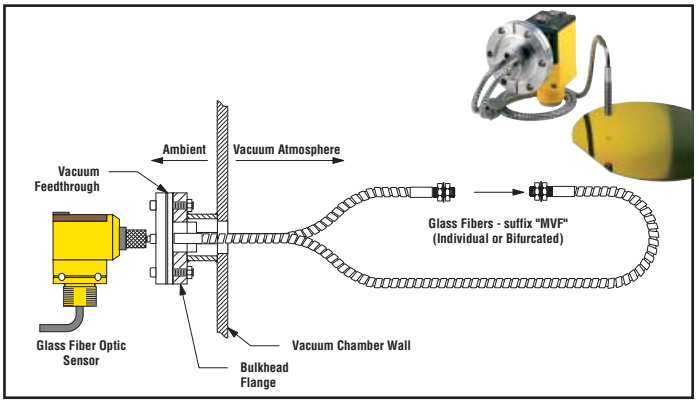


Figure 17. Fiber optic use in a hostile environment

Figure 18. NAMUR sensors are safely used in explosive environments

Sensing Modes

Each photoelectric sensor is designed for one of several basic sensing modes: opposed, retroreflective, polarized retroreflective, diffuse, divergent, convergent, fixed-field and adjustable-field. Diffuse, divergent, convergent, fixed-field and adjustable-field modes are sometimes grouped into the "photoelectric proximity mode" category (not to be confused with capacitive proximity or inductive proximity sensors). Fiber optic sensors may be configured in the opposed mode (using single fibers) or any of the photoelectric proximity modes (using bifurcated fibers). Ultrasonic sensors are designed for either opposed- or proximity-mode sensing.

Opposed Mode

Opposed-mode sensing may also be called "direct-scanning," "beam-break" or "through-beam" mode. Opposed-mode emitters and receivers are positioned opposite each other, with the emitter's light aimed directly at the receiver. An object is detected when it interrupts the sensing path between the two components, "breaking" the beam; see Figure 19.

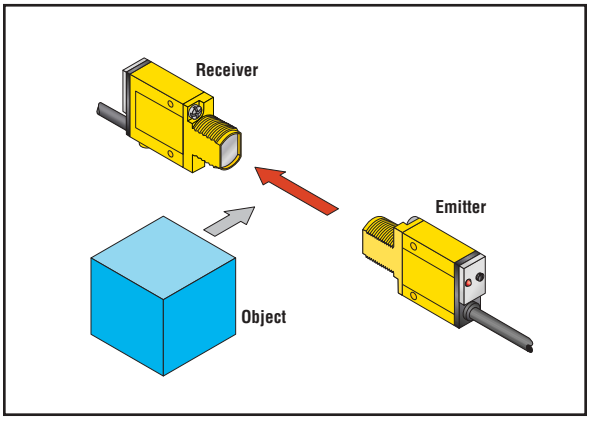


Figure 19. Opposed mode senses a target object when it breaks the beam

Opposed mode was the first photoelectric sensing mode used. In the early days of non-modulated sensors, problems with difficult emitter-receiver alignment gave this mode a bad reputation. Today's high-powered modulated photoelectric sensors, however, are easy to align.

Alignment — Opposed Mode

Sensor alignment means positioning the sensor(s) so that maximum emitted light reaches the receiver element. In opposed sensing, the emitter's light is centered on the receiver's field of view.

For simple alignment when using a visible LED emitter, place a retroreflective target directly in front of the receiver lens. Align the emitter by sighting the visible beam on the target. Remove the retro target and "fine-tune" the emitter-receiver orientation using the sensor's excess gain indicator for optimal alignment.

Sensing Range — Opposed Mode

Sensing range is an important sensor specification, used for comparison. For opposed sensors, range is the maximum operating distance between the emitter and the receiver. A sensor's effective beam is the "working" part of the beam: the portion of the beam that must be completely interrupted in order for an object to be reliably sensed. The effective beam of an opposed-mode sensor pair may be pictured as a rod connecting the emitter lens (or ultrasonic transducer) to the receiver lens (or transducer); see Figure 20. The "rod" will taper if the two lenses (or transducers) are of different sizes. The effective beam is not the same as the emitter's radiation pattern, or the receiver's field of view.

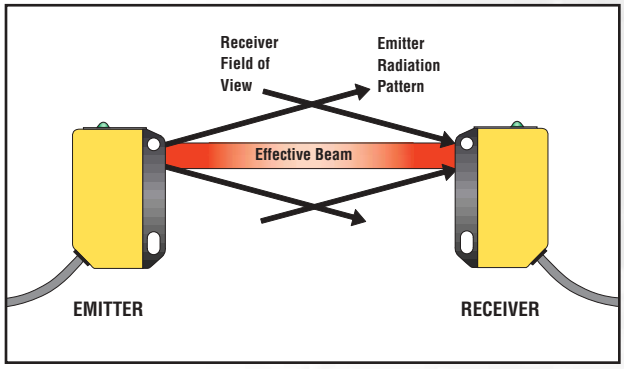


Figure 20. The effective beam of an opposed emitter/receiver pair extends from the edges of the emitter to the edges of the receiver element

The effective beam size of an opposed-mode photoelectric sensor pair may be too large to detect small parts, to inspect small profiles, or for very precise position sensing. In such cases, the sensor lenses (emitter and/or receiver) can be apertured to reduce the effective beam size (Figure 21). Some sensors have accessory apertures that attach to the sensor lens; creating an aperture can be as easy as drilling a hole or milling a slot in a thin metal plate, and locating it directly in front of the lens, with the opening on the lens centerline. (When selecting an aperture material, remember that the powerful beam of modulated opposed-mode sensors can penetrate some non-metallic materials.)

Apertures reduce the light energy passing through a lens by an amount equal to the lens area reduction (the smaller the aperture, the less light can pass). For example, if a 20 mm diameter lens is apertured down to 5 mm diameter, the amount of optical energy passing through the apertured lens is equal to $(1/4)^2$ or $1/16^{th}$ of the energy allowed through the 20 mm lens. The energy loss doubles if apertures are used on both the emitter and the receiver.

A rectangular aperture of any width restricts much less light-gathering lens area than does a round aperture of the same diameter. For this reason, rectangular "slit" apertures should be used if the target objects travel past the beam with a predictable orientation (as in edge detection). When small objects move more randomly through the beam, round apertures are required.

If the object to be detected will always pass very close to either the emitter or the receiver, an aperture may be required on only one lens. In such cases, the effective beam size is equal to that of the aperture on one side, uniformly expanding to the size of the unapertured lens; it is therefore "cone-shaped."

Figure 21. An aperture reduces the size of the emitted beam

The goal for any opposed-beam application to detect small parts is to size the effective beam to be smaller than the smallest target profile, while retaining as much lens area as possible. An easy way to match a part profile to a beam is to use a fiber optic assembly with a sensing end terminated in the target object's shape and/or size; see Figure 14.

The very high power (especially at close range) of some modulated LED opposed sensor pairs can create a "flooding" (or halo) effect of light energy around an object that is larger than the effective beam. This is another reason for the size of the effective beam to be smaller than the profile of the target object.

It is possible to shape an opposed ultrasonic wave pattern by using waveguides. Waveguides attach to the receiver transducer (and sometimes to the emitter). With waveguides attached, the receiver is less likely to respond to sound echoes approaching from the side, providing more reliable detection of small objects.

Retroreflective Mode

In retroreflective (also called "reflex" or "retro") mode, one sensor contains both emitter and receiver circuitry (Figure 22). Its emitter sends a light beam to a retroreflective target, which reflects the light back to the receiver. As in opposed-mode sensing, an object is sensed when it interrupts the beam.

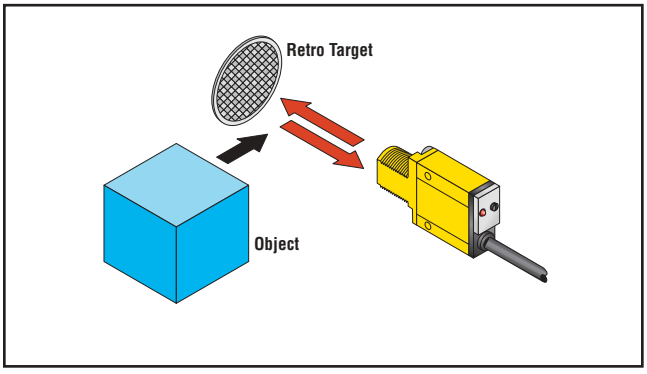


Figure 22. The retroreflective target reflects the emitted beam back to the receiver

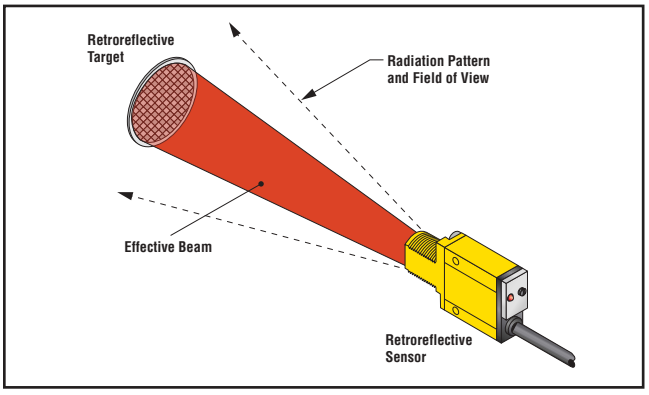


Figure 23. The effective beam forms a cone from the sensor lens to the edges of a retroreflective target

Retroreflective range is the distance from the sensor to its retroreflective target. The effective beam is usually cone-shaped, connecting the rim of the sensor lens (or lens pair) to the retroreflective target's rim. Exceptions to this are at close range, where the size of the retro beam can not expand enough to fill the target, or when very precise laser beams are used. The effective beam never exceeds the size of the reflector.

Retroreflective targets ("retroreflectors" or "retro targets") are usually a matrix of tiny corner-cube

prisms, each with three mutually perpendicular surfaces and a hypotenuse face. A light beam entering a corner-cube prism through its hypotenuse face is reflected from the three surfaces and emerges back through the hypotenuse face, parallel to the entering beam (Figure 24). In this way, the retroreflective target returns the light beam to its source.

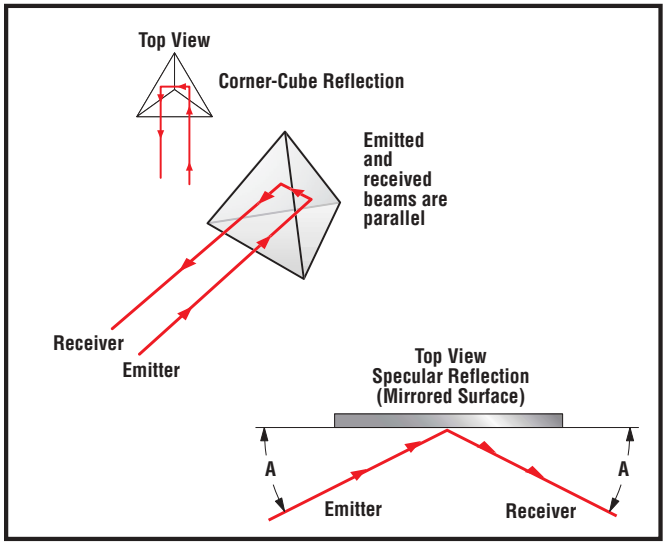


Figure 24. Corner-cube retroreflective targets reflect the emitted beam back to its source

Most corner-cube retroreflectors are molded of transparent acrylic plastic, in many sizes, shapes, and colors. Corner-cube plastic retroreflectors often are used for vehicle safety reflectors, appearing brightly illuminated to a driver when the vehicle's headlights are returned by the array of corner cubes. Highway markers may be wrapped in retroreflective tape, which is coated with microscopic molded corner-cube reflectors or microscopic glass beads. (A clear glass sphere also returns a light beam to its source, but a coating of glass beads is a less efficient reflector than are molded corner cubes.)

Figure 25. Corner-cube retroreflective targets are available in many shapes and sizes, including reflective tape

A mirrored surface also may be used as a retroreflector. Light striking a flat mirrored surface, however, reflects at an angle equal and opposite to the angle of incidence ("specular reflection"; see Figure 24). In order for a retroreflective sensor to "see" its light reflected from a mirrored surface, the emitted beam must be positioned exactly perpendicular to the surface. A retroreflector, on the other hand, can return incident light back to its source at angles up to about 20° from perpendicular. This simplifies the alignment of retroreflective sensors to their retro targets.

A good retroreflector returns about 3,000 times as much light to its sensor as does a piece of white paper. For this reason, it is easy for a retroreflective sensor to recognize only the light returned from its retroreflector. However, if the target object interrupting the beam is itself highly reflective, it may reflect light back to the sensor and slip through the beam without being detected. This problem is called "proxing", and relatively simple methods exist to deal with it.

If a flat, shiny object passes through a retroreflective beam with a predictable orientation, the cure for proxing is to orient the beam so that the object's flat surface reflects the beam away from the sensor ("scanning at a skew angle"). The angle usually need be skewed only 10° to 15° to be effective (Figure 26). This becomes more complicated, how-

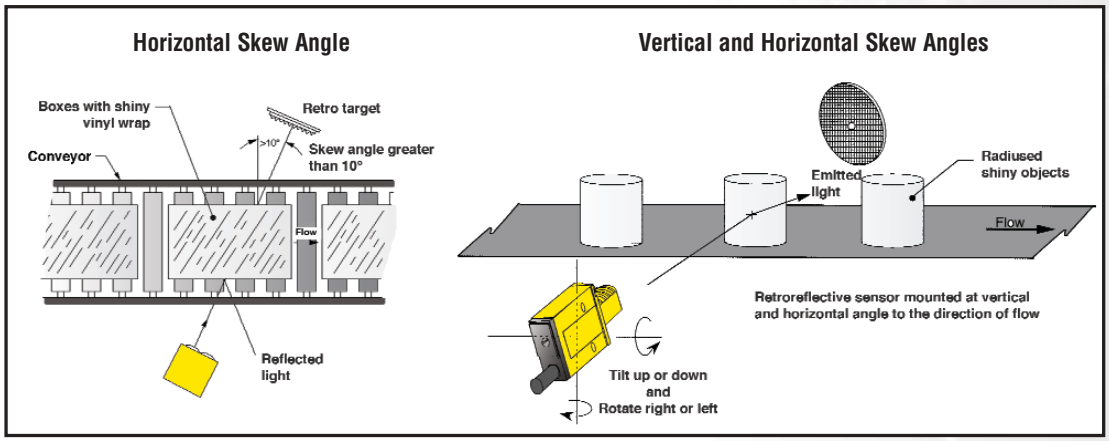


Figure 26. Using a skew angle to eliminate proxing

ever, if the shiny object has a rounded surface or if it encounters the beam at unpredictable angles. In such cases, position the beam to strike the object at both a vertical and a horizontal skew angle. The skew-angle approach is often the best insurance against proxing. When this is not possible, consider polarization or opposed-mode sensing.

Polarization

Polarizing (or "anti-glare") filters may be used with visible retroreflective sensors to significantly reduce the potential for proxing. The filters are placed in front of both the emitter and receiver lenses, oriented with their planes of polarization at 90° to one another.

When light is emitted, it is polarized "vertically" (Figure 27). This vertically-polarized emitted light is de-polarized when it travels through the plastic lens of a typical retroreflector. The horizontal component of the de-polarized light is allowed to pass through a horizontal polarizer, which is placed in front of the sensor's receiver element.

However, when the vertically-polarized emitted light is reflected from a shiny surface, it remains vertically-polarized. This light is blocked from reaching the sensor's receiver by the horizontal polarizer.

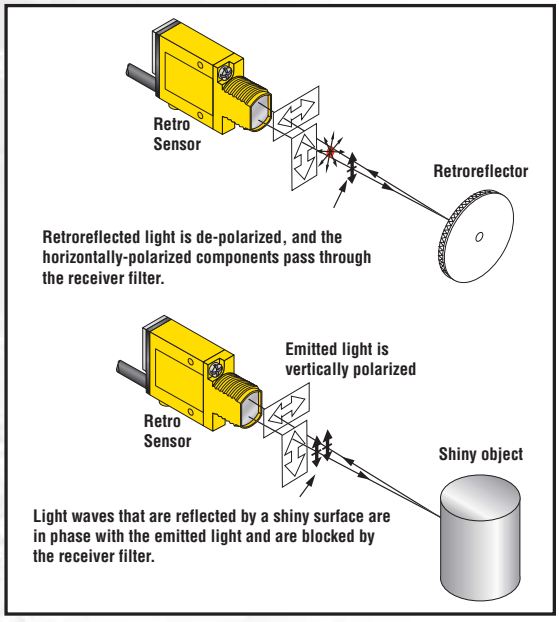


Figure 27. Polarization of the emitted light helps reduce "proxing" from shiny objects

Polarizing filters effectively eliminate proxing but, like a pair of sunglasses, they also reduce the beam's available optical power by 50 percent or more. This is important if the sensing environment is dirty or if the sensing range is long. Polarized retro sensors work only with corner-cube-type retroreflectors.

Alignment — Retroreflective Mode

With recent improvements in LED technology, the use of visible-light LED emitters has increased. When equipped with a visible emitter, a retro sensor may be aimed like a flashlight at its retroreflective target. When the beam's reflection is visible on the retroreflector, correct alignment is assured.

Figure 28. Retroreflective sensors with visible light emitters make alignment easy

Proximity Modes

Photoelectric or ultrasonic proximity-mode sensing detects an object directly in front of the sensor by detecting the sensor's own transmitted energy reflected back from the object's surface (Figure 29). For example, an object is sensed when its surface reflects a sound wave back to an ultrasonic proximity sensor. Both the emitter and receiver are on the same side of the object, usually in one housing. In proximity sensing modes, an object "makes" (establishes) the beam when it is present, rather than interrupting it, as in opposed-mode sensing. Photoelectric proximity sensors have a variety of optical arrangements: diffuse, divergent, convergent, fixed-field, and adjustable-field.

Diffuse Mode

Diffuse-mode sensors are a popular type of photoelectric proximity sensor. In diffuse mode, the emitted light strikes the surface of an object at some arbitrary angle. The light diffuses from that surface at many angles, some small portion of which reaches the receiver.

Diffuse sensing is relatively inefficient, because the receiver looks for a small amount of returned light. And like other proximity sensing modes, diffuse mode is dramatically influenced by the reflectivity of the surface being sensed. A bright white surface will be sensed at a longer range than will a dull black surface.

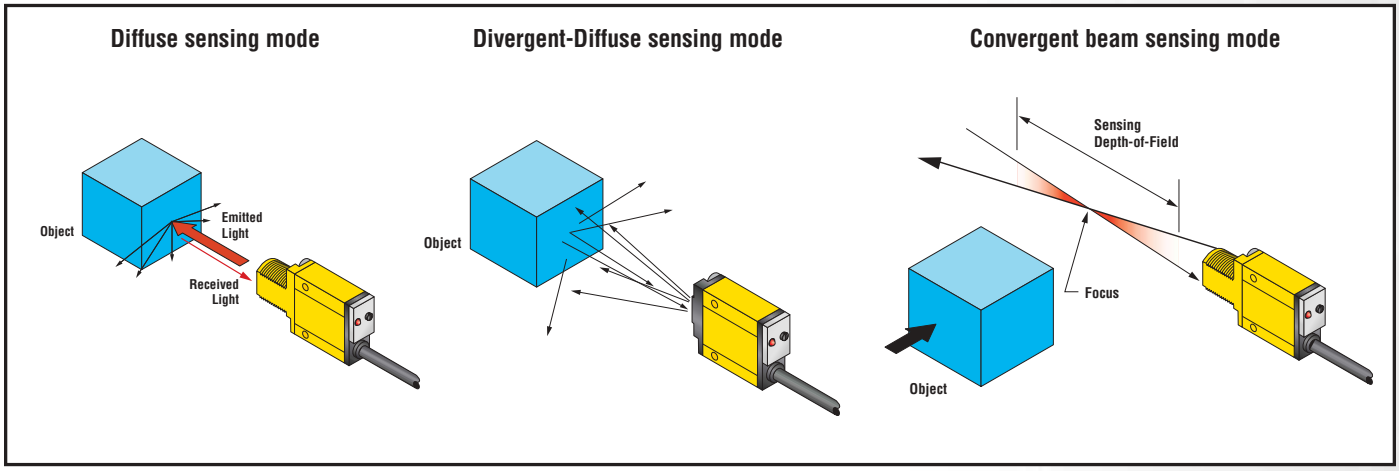


Figure 29. Proximity modes take several forms, but all require reflecting light or sound from the target object back to the receiver

Most diffuse-mode sensors use lenses to collimate (make parallel) the emitted light rays and gather in more received light. While lenses help to extend diffuse sensing range, they also make the sensing angle to a shiny or glossy surface more critical. (Because shiny surfaces are somewhat mirror-like, the beams reflecting off them tend to reflect away from the sensor, rather than back to the diffuse receiver.)

Most diffuse sensors can rely on a returned light signal only if the surface of a shiny target is perfectly parallel to the sensor lens (Figure 30). This may be impossible with radiused parts, such as shiny cans, and presents a concern when detecting webs of metal foil or poly film where web "flutter" may occur.

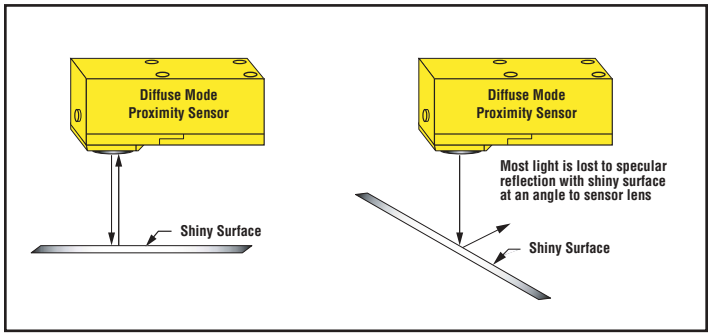


Figure 30. In diffuse sensing, the sensor lens must remain parallel to a shiny surface for reliable detection

Divergent (Wide-Angle) Diffuse Mode

To avoid the effects of signal loss from shiny objects, special short-range, unlensed divergent-mode sensors should be considered. Eliminating the collimating lens shortens the sensing range, but also lessens the sensor's dependence upon the angle of incidence of its light to a shiny surface within its range. See Figure 29.

The range of any proximity mode sensor also is affected by the size and profile of the target to be detected. A large object that fills the sensor's beam area will return more energy to the receiver than will a small object that only partially fills the beam.

A divergent sensor responds better to objects within about 2.5 mm than does a diffuse-mode sensor. As a result, divergent-diffuse sensors can successfully sense such small profiles as yarn or wire, if they can be positioned near the sensing lenses.

Convergent Mode

Another photoelectric proximity mode effective for sensing small objects is convergent-beam mode. Most convergent sensors use a lens system to focus the emitted light to an exact point in front of the sensor, and focus the receiver element at the same point. This produces a small, intense, well-defined sensing area at a fixed distance from the sensor lens (Figure 29).

Convergent mode uses reflective sensing energy efficiently. It reliably senses small objects, and also materials of very low reflectivity that cannot be sensed with diffuse- or divergent-mode sensors.

Sensing Range — Convergent Mode

The range of a convergent-beam sensor is its focus point, which is fixed. This means that the distance from a convergent-beam device to the sensing surface must be rather closely controlled. A convergent sensor will detect an object at its focus point, plus-or-minus a certain distance; this sensing area, centered on the focus point, is the sensor's depth of field. The depth of field size depends upon the sensor design and the target object's reflectivity. The depth of field of precise-focus convergent-beam sensors is very small; they may be used for precise position sensing or profile inspection.

It often is necessary to detect objects passing the sensor within a specified range while ignoring other stationary or moving objects in the background. One advantage of convergent sensing is that objects beyond the depth of field are ignored. Remember, however, that the near and far limits of the depth of field depend upon the reflectivity of objects in the scan path. (Reflective backgrounds will be sensed at a greater distance than will less reflective objects in front of them.)

Color mark sensing (or register mark sensing) is a specialized convergent sensing application, in which a precise-focus convergent sensor detects register marks, usually for positioning products or materials. LED color is important in determining the color contrasts that can be sensed. While several beam colors are available to distinguish between virtually any combination of colors, blue-green LEDs have been found useful for a wide variety of color-sensing applications, including 20% yellow on white.

Figure 31. The narrow, sharply defined sensing beam of a PicoDot laser diode sensor detects the edge of a semiconductor wafer in a wafer cassette mapping application

Laser diode convergent sensors produce a tiny, concentrated focus point, perhaps 0.25 mm dia. at 100 mm. They are ideal for detecting small parts and as robotic end effector sensors. With their high sensing power, they often can detect objects that are not reflective enough to be sensed with conventional LEDs.

Fixed-Field Mode

Fixed-field sensing is a photoelectric proximity mode that has a definite limit to its sensing range. Fixed-field sensors (Figure 32) ignore objects beyond their sensing ranges, regardless of the object's surface reflectivity.

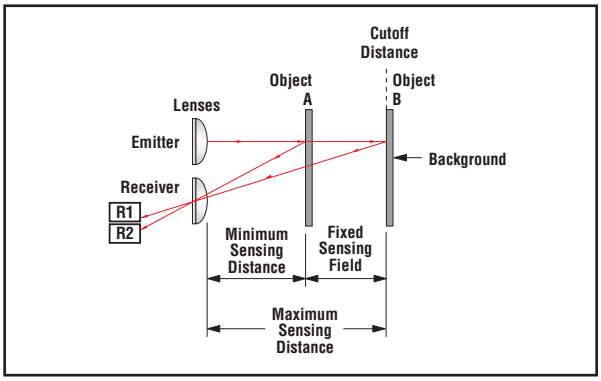


Figure 32. In fixed-field mode sensing, a target object is sensed if the amount of light at R2 is equal to or greater than that at R1

Fixed-field sensors compare the amount of reflected light seen by two differently-aimed receiver elements. A target is recognized as long as the amount of light reaching receiver R2 is equal to or greater than that "seen" by R1.

Adjustable-Field Mode

Like fixed-field models, adjustable-field sensors have the ability to distinguish between objects placed at various distances from the sensor; in this case, the distances are adjustable. An adjustable-field sensor receiver produces two currents: I1 and I2 (Figure 33). The ratio of the currents changes as the received light signal moves along the length of the receiver element. The sensing cutoff distance relates directly to this ratio, which is set using an electronic or mechanical adjustment. Even reflective objects located beyond the cutoff distance (for example, object "B") are ignored.

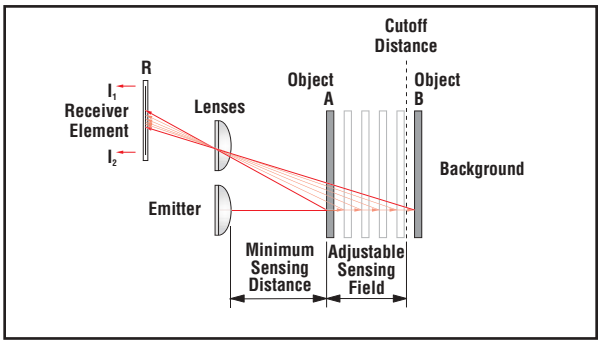


Figure 33. In adjustable-field sensing, objects beyond the cutoff distance are ignored, while nearer objects are sensed

Fiber-Optic Modes

Not actually a sensing mode, fiber-optic sensors can function in any of the photoelectric modes. Individual fibers may be configured for opposed-mode sensing, and bifurcated fibers may be configured for retroreflective or proximity sensing. Specialized fibers are available; the fibers shown in Figure 34 are mechanically configured inside the molded sensing tip for convergent-mode sensing.

Figure 34. This plastic fiber is specially designed for short-range convergent sensing

Ultrasonic Proximity Mode

Ultrasonic transducers vibrate when ac voltage is applied. The vibration alternately compresses and expands air molecules to send "waves" of ultrasonic sound outward from the transducer's face. The transducer also receives "echoes" of ultrasonic waves located within its response pattern.

Ultrasonic sensors are categorized by transducer type: electrostatic or piezoelectric (Figure 35). Electrostatic sensors are used for very-long-range proximity detection; often up to 6 or 7 meters. These long-range sensors are often used to monitor levels in large bins or tanks. Piezoelectric sensors usually have a much shorter sensing range, typically up to 1 meter, but can be sealed for protection from harsh operating conditions.

Figure 35. Ultrasonic sensors: eletrostatic (center) and piezoelectric

In general, ultrasonic proximity sensors are affected less by target surface characteristics than are diffuse-mode photoelectrics. However, the transducer face must be within 3° of parallel to smooth, flat target objects. (This angle becomes less critical when sensing the sound-scattering surfaces of irregular materials.) Sound-absorbing materials, such as cloth or foam, are poor targets for ultrasonic proximity sensors. Also, because small objects return less sound energy, target size is an important consideration in sensor selection.

Ultrasonic proximity sensors offer excellent sensing repeatability when target objects move perpendicular to the sensing face. Consequently, they are used frequently to measure distances. Some have adjustable sensing window limits and/or analog outputs which produce a voltage or current proportional to the object's position within the sensing window. Digital filtering can provide immunity to electrical and/or acoustical noise. Analog outputs can be highly linear, and temperature-compensated models are available for environments with wide ambient temperature shifts.

Ultrasonic proximity-mode sensors are also available as controllers, to be paired with remote transducers. These small remote transducers can operate in tight locations, while the full-sized controller provides full-featured sensing and output capabilities. Opposed-mode ultrasonic sensors, with separate emitter and receiver housings, are ideal for sensing transparent materials.

Figure 36. An ultrasonic sensor detects the fill level in a tank

Beam Patterns

A beam pattern is an important tool for predicting how a photoelectric sensor will perform in an application. Beam patterns are drawn in two dimensions; symmetry around the optical axis is assumed, and the pattern's shape is assumed to be the same in all sensing planes (but this is not always true). Beam patterns assume perfectly clean sensing conditions, optimal sensor alignment, and the proper sensor sensitivity (gain) setting for the specified range. Maximum light energy occurs along the sensor's optical axis, decreasing as it moves toward the edges of the beam pattern. Beam pattern dimensions are typical for the described sensor in each sensing mode, but should not be considered exact.

Opposed-Mode Beam Patterns

For opposed sensors, the beam pattern is the area within which the receiver will effectively "see" the emitted beam. The horizontal scale is the distance between the emitter and receiver; the vertical scale is the width of the active beam, measured on either side of the optical axis between the emitter and receiver lenses.

It is assumed that the emitter and receiver are perfectly aligned, that is, the optical axis of the emitter lens is kept exactly parallel to the optical axis of the receiver lens when the pattern is plotted. Even slight misalignment significantly affects the sensing area size of most opposed sensor pairs, except at close range.

Opposed-mode beam patterns predict how closely multiple parallel sensor pairs may be mounted, without generating optical crosstalk between the pairs. A typical pattern is shown in Figure 37. It predicts that, at an opposed sensing distance of 1.2 meters, a receiver kept perfectly parallel to its emitter will "see" enough light to operate at up to just under 200 mm in any direction from the emitter's optical axis. This means that adjacent emitter/receiver pairs may be placed parallel to each other as close as about 250 mm apart (200 mm plus a slight "safety factor") without creating crosstalk from an emitter to the wrong receiver.

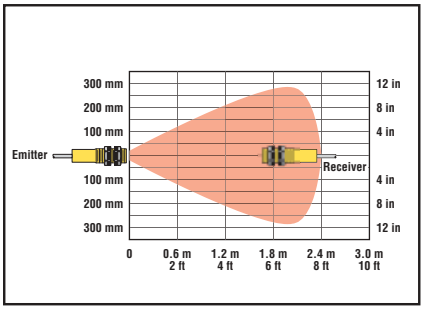


Figure 37. Typical opposed-mode beam pattern

Parallel sensor pairs may be be located twice as close by alternating the emitter/receiver location on each side of the sensing area, as shown in Figures 38 and 39. If only two opposed beams are used, they may be placed in this manner as closely together as the sensor dimensions permit, without causing direct optical crosstalk. However, if emitters and receivers

on one side of the sensing area are located close together (typically 50 mm or less) the potential for reflective crosstalk ("proxing") increases. Because opposed-mode receivers are "looking" for "dark" (blocked beam) for object detection, light detected by a receiver due to reflective crosstalk may allow an object to slip through the sensing area undetected.

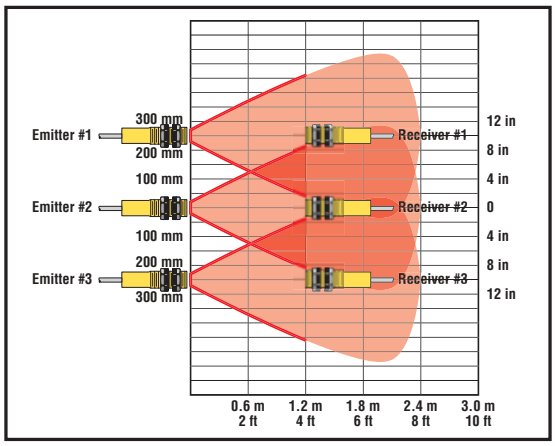


Figure 38. Overlapping beam patterns for three opposed emitter/receiver pairs indicate the minimum separation required to avoid crosstalk between adjacent pairs

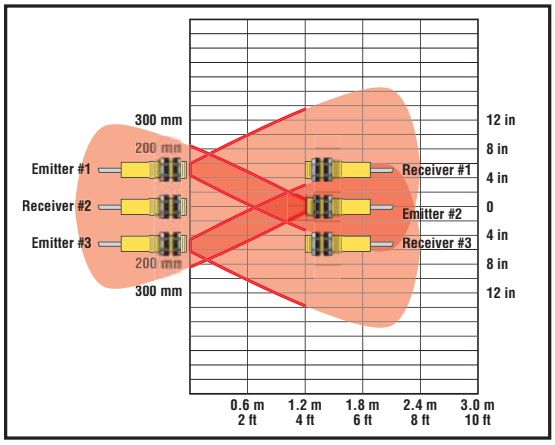


Figure 39. Position adjacent opposed emitter/receiver pairs in opposite directions to reduce crosstalk

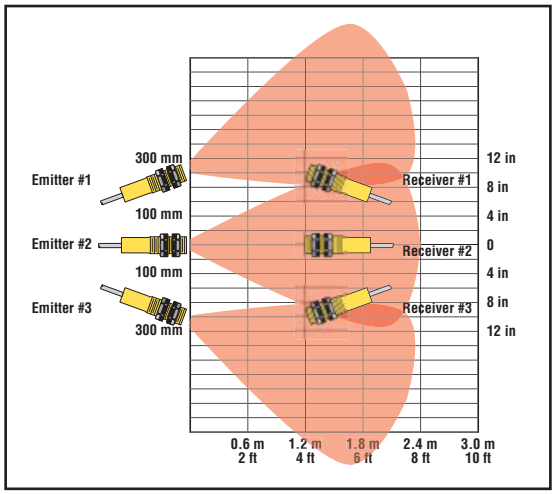


Figure 40. Emitters #1 and #3 are intentionally misaligned to avoid crosstalk with receiver #2

Another method to minimize optical crosstalk between adjacent opposed sensor pairs is to angle the emitter or receiver mounting slightly, to intentionally misalign the outermost sensor pair(s). As shown in Figure 40, emitters #1 and #3 are rotated to direct their beams slightly away from the view of receiver #2.

Separating adjacent emitter/receiver pairs both horizontally and vertically (diagonally) also reduces crosstalk; the beam pattern determines the required separation distance. In this way, adjacent beams may be located closer – in one dimension. This approach is possible if the object to be sensed is large, and when available sensor mounting space permits.

If adjacent opposed beams must be placed very closely in an array, optical crosstalk can be eliminated by using a multiplexed light screen. A light screen incorporates multiple individual photoelectric sensors into two compact housings, enabling (turning on) each modulated emitter in sequence, only when its associated receiver is "looking" for the beam. This eliminates the chance of false response by any receiver to the wrong light source. Light screens are used for on-the-fly object profiling, part ejection verification, parts counting and similar applications.

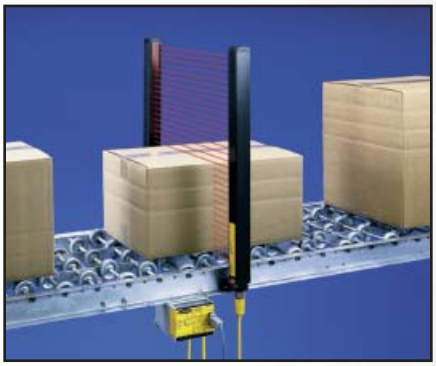


Figure 41. The MINI-ARRAY is an example of a multiplexed light screen

Opposed-mode beam patterns also help to predict the area within which an emitter and receiver will align when one sensor moves relative to the other, as with automatic vehicle guidance systems. The beam pattern represents the largest typical sensing area when sensor sensitivity is adjusted to match range specifications. The beam pattern boundary will shrink as sensitivity decreases, and may expand as sensitivity increases.

Retroreflective-Mode Beam Patterns

Banner's retroreflective-mode beam patterns usually are plotted using a 150 mm-diameter plastic corner-cube retroreflective target positioned perpendicular to the sensor's optical axis (unless otherwise noted). The pattern represents the boundary within which the sensor will respond to the target (Figure 42).

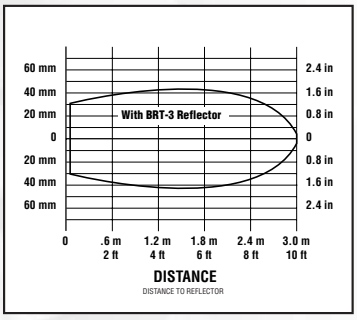


Figure 42. Typical retroreflective-mode beam pattern

The beam pattern's horizontal scale represents the distance from the retro sensor to the retroreflector. The vertical scale is the farthest distance on either side of the sensor's optical axis where the reflector can establish a retroreflective beam with the sensor.

The retroreflective beam pattern predicts how one 150 mm target will interact with multiple parallel retroreflective sensors mounted closely together. It also predicts whether a 150 mm reflector will be detected if it is traveling (parallel) past the sensor at a given distance.

Most important, the pattern accurately depicts the size of the active beam at longer distances (a meter or more) from the sensor. It is best to capture the entire emitted beam on the retroreflective target; the pattern indicates how large a reflector is needed at any distance where the beam expands to larger than 150 mm across.

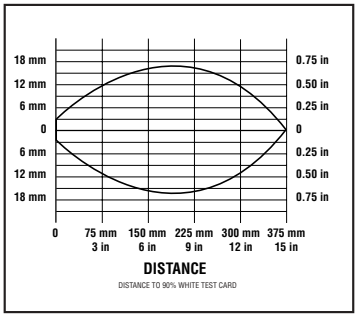
Proximity-Mode Beam Patterns

The beam pattern for photoelectric proximity-mode sensors represents the area within which the edge of a light-colored diffuse surface will be detected as it moves past the sensor. Beam patterns for diffuse-, convergent-, divergent-, fixed-field- and adjustable-field-mode sensors are developed using a Kodak 90% reflectance white test card (which is about 10% more reflective than white copy paper). The beam pattern is smaller for less reflective materials, and may be larger for more reflective surfaces.

The test card used to plot the pattern measures 200 mm by 250 mm; beam patterns using this standard target are not necessarily identical to real-world sensing applications. When substantially smaller objects are sensed at long ranges, the beam pattern's size may decrease. And when a shiny surface is sensed at an angle, the size and shape of the beam pattern changes dramatically.

The pattern's horizontal scale is the distance from the sensor to the reflective surface. The vertical scale is the width of the active beam, measured on either side of the optical axis (Figure 43). The beam pattern for any diffuse, convergent, divergent, fixed-field, or adjustable-field sensor is equivalent to the sensor's effective beam.

Figure 43. Typical beam pattern for a diffuse-mode photoelectric sensor



The beam pattern (more commonly called the response pattern) for an ultrasonic proximity sensor is drawn for a square, solid, flat surface (Figure 44); the target size is specified for each type of sensor. The size of the real-world response pattern is affected by the size, shape, texture, and density of the material being sensed.

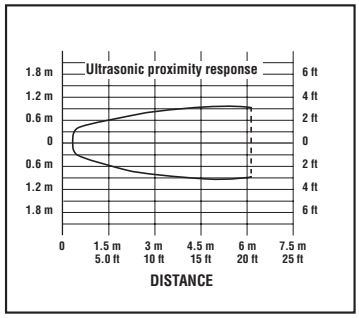


Figure 44. Typical response pattern for an ultrasonic proximity-mode sensor

Excess Gain

Excess gain (E.G.) is an important specification, used to predict the reliability of a photoelectric sensing system. As its name suggests, it is a measurement of light energy falling on the receiver, over and above the minimum required to operate the sensor's amplifier.

Once a signal is established between an emitter and receiver, attenuation (reduction) of that signal may result due to dirt, dust, smoke, moisture, or other environmental contaminants. The sensor's excess gain may be described as the extra sensing energy available to overcome this attenuation.

To determine excess gain for an application, use the formula:

$$\text{Excess Gain} = \frac{\text{light energy falling on the receiver element}}{\text{the sensor's amplifier threshold}}$$

The sensor's amplifier threshold is the level of sensing energy required by the amplifier to change its output state (to switch on or off). In a modulated photoelectric sensor, excess gain is measured as a voltage (typically in millivolts), often at the first stage of receiver amplification. This voltage, compared to the amplifier's threshold voltage level, determines the excess gain. An excess gain of one (expressed "1x" or "one times") occurs when the measured voltage is at the amplifier threshold level.

If 50% of the emitted light energy becomes attenuated, a minimum of 2x (two times) excess gain is required to overcome the light loss. Similarly, if 80% of a sensor's light is lost to attenuation (only 20% is left), then an available excess gain of at least 5x is required.

If the sensing conditions are known, the excess gain levels listed in Table 1 may be used as a guideline to assure that the sensor's light energy will not be entirely lost to attenuation.

The table lists an excess gain of 1.5x (50% more energy than required for minimum operation) for a perfectly clean environment. This includes a "safety" factor for subtle sensing variables such as gradual sensor misalignment and small changes in the sensing environment. At excess gains above 50x, opposed-mode sensors will begin to burn through ("see" through) paper and other materials of similar optical density.

Minimum Excess Gain Required	Operating Environment
1.5x	***Clean air:*** no dirt buildup on lenses or reflectors
5x	***Slightly dirty:*** slight buildup of dust, dirt, oil, moisture, etc. on lenses or reflectors. Lenses are cleaned on a regular schedule.
10x	***Moderately dirty:*** obvious contamination of lenses or reflectors (but not obscured). Lenses cleaned occasionally or when necessary.
50x	***Very dirty:*** heavy contamination of lenses. Heavy fog, mist, dust, smoke, or oil film. Minimal cleaning of lenses.

Table 1. Guidelines for excess gain values

Excess gain may be plotted as a function of sensing distance (Figure 45). Excess gain curves for Banner sensors represent the lowest guaranteed excess gain available from each model, plotted for perfectly clean conditions and maximum receiver gain. Most sensors are factory-calibrated to the excess gain curve. Some have a gain adjustment (or "sensitivity" control) that can be field-adjusted to exceed the excess gain specifications (however, this is not always possible).

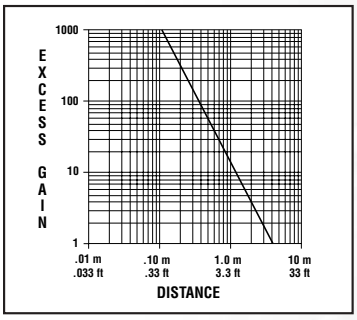


Figure 45. Typical opposed-mode excess gain curve

The excess gain curve in Figure 45 suggests that operation of this opposed sensor pair is possible in a perfectly clean environment (excess gain ≥ 1.5x) at distances up to 3 meters apart, or in a moderately dirty area (excess gain ≥ 10x) up to 1.2 meters apart. At distances inside 0.3 meters, these sensors will operate in nearly any environment.

Sensors indicate excess gain in several ways, often a system of blinking or solid LEDs. Signal strength indicators provide a visual indication of marginal signal strength; some displays flash a warning LED and/or energize an alarm output signal whenever excess gain approaches 1x.

Excess Gain — Opposed-Mode Sensing

The relationship between excess gain and sensing distance is unique for each photoelectric sensing mode. For example, the excess gain of an opposed-mode sensor pair is directly related to sensing distance by the inverse square law. If the sensing distance doubles, excess gain reduces by a factor of $(1/2)^2 = 1/4$. Similarly, if the sensing distance triples, excess gain reduces by a factor of $(1/3)^2 = 1/9$, and so on. As a result, the excess gain curve for opposed-mode sensors, plotted on a log-log scale, is always a straight line.

Because the emitted light goes directly to the receiver, opposed-mode sensing makes the most efficient use of sensing energy. Therefore, the excess gain available from opposed-mode sensors is much greater than from any other photoelectric sensing mode.

Excess Gain — Retroreflective-Mode Sensing

The shapes of excess gain curves for other sensing modes are less predictable. Retroreflective excess gain curves are plotted using a 150 mm dia. retroreflector, except where noted; the shape of the excess gain curve is affected by the size of the retroreflective target. Several targets, clustered together, usually result in longer sensing range and higher excess gain (Figure 46). A small corner-cube reflector yields a smaller curve. The type of retroreflective target material used also affects excess gain. Generally speaking, reflectors with a higher reflectivity factor (as listed in this catalog) provide higher excess gain.

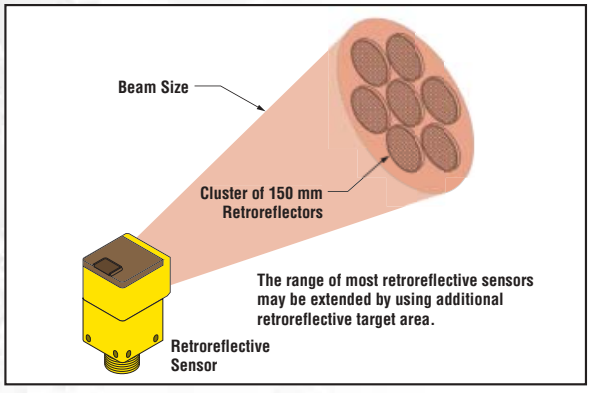


Figure 46. Extending retroreflective range

Designed for long-range performance, most retroreflective sensors have separate emitter and receiver lenses. A good retro target returns most of the incoming light directly back to the sensor; at close range, most of the returning light comes directly back into the emitter lens (see Figure 47).

As a result, two-lens retroreflective sensors tend to have a "blind spot" at close range, evident on excess gain curves (see Figure 48). For this reason, special single-lens sensors are used for close-in retro sensing. Some models with coaxial optics can sense retro material in contact with the lens itself.

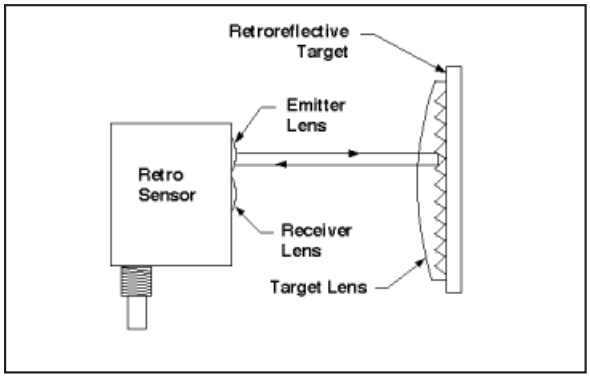


Figure 47. Retroreflective "blind spot"

Figure 48. Typical excess gain curve for a retroreflective-mode sensor (using a 150 mm reflective target)

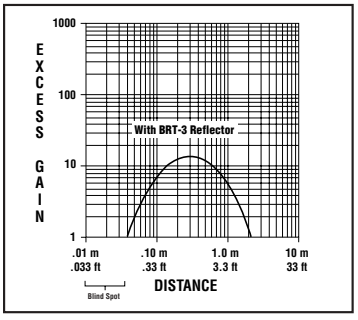


Figure 48 illustrates an important consideration, especially when retroreflective sensors are used in dirty locations. Because the light energy passes through two lens surfaces on each direction of the sensing path (the sensor and the reflector), attenuation doubles in both directions. Therefore, in a dirty sensing environment, excess gain drops off twice as fast in a retroreflective system than in an opposed system.

Excess Gain — Proximity-Mode Sensing

Photoelectric proximity modes tend to be less efficient sensing modes. The receiver must "look" for a relatively small amount of light reflected from the surface of a target object. As a result, the excess gain available from a proximity-mode sensor usually is lower than that of other photoelectric sensing modes.

Curves for diffuse, convergent, divergent, fixed-field, and adjustable-field sensors are plotted using a Kodak 90% reflectance white test card for reference. Diffuse-mode excess gain performance varies dramatically, depending on the reflectivity of the surface being sensed.

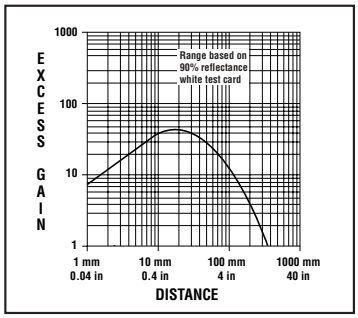
Any surface may be ranked for reflectivity, compared to the Kodak reference card (Table 2). The "Excess Gain Required" column indicates the minimum excess gain required to sense each material. For example, the diffuse sensor described in Figure 49 will "see" opaque black plastic targets (6.4x excess gain required), up to 40 mm away, under perfect sensing conditions.

Material	Reflectivity	Excess Gain Required
Kodak white test card	90%	1
White paper	80%	1.1
Newspaper (with print)	55%	1.6
Tissue paper: 2 ply	47%	1.9
1 ply	35%	2.6
Masking tape	75%	1.2
Kraft paper, cardboard	70%	1.3
Dimension lumber (pine, dry, clean)	75%	1.2
Rough wood pallet (clean)	20%	4.5
Beer foam	70%	1.3
Clear plastic bottle*	40%	2.3
Translucent brown plastic bottle*	60%	1.5
Opaque white plastic*	87%	1.0
Opaque black plastic (nylon)*	14%	6.4
Black neoprene	4%	22.5
Black foam carpet backing	2%	45
Black rubber tire wall	1.5%	60
Natural aluminum, unfinished*	140%	0.6
Natural aluminum, straightlined*	105%	0.9
Black anodized aluminum, unfinished*	115%	0.8
Black anodized aluminum, straightlined*	50%	1.8
Stainless steel, microfinish*	400%	0.2
Stainless steel, brushed*	120%	0.8

* For shiny materials, the reflectivity figure represents the maximum light return, with the sensor beam exactly perpendicular to the surface.

Table 2. Relative reflectivity of commonly sensed materials

Figure 49. Typical excess gain curve for a diffuse-mode sensor



To find the required excess gain for diffuse sensing of any material in any environment, multiply the material's reflectivity factor by the excess gain level required for the sensing conditions (from Table 1). For example, to sense black opaque plastic in a slightly dirty environment, the minimum required excess gain is:

6.4 (reflectivity factor) x 5 (min'm req'd excess gain) = 32 (Excess gain required)

Under these conditions, the diffuse sensor described in Figure 49 will reliably sense the black plastic from 12 to 100 mm, even with a slight build-up of dirt on the lens.

The size and profile of the object being detected also affects the excess gain of diffuse-mode sensors. Excess gain curves assume a white test card that fills the entire area of the sensor's effective beam. If the object fills only a portion of the effective beam, proportionately less light energy will be returned to the receiver.

Like diffuse-mode sensing, the excess gain of divergent-mode sensors is affected by the reflectivity and size of the target object. However, these variables are less noticeable with divergent sensing, because divergent-mode sensors have such a short operating range.

Because most of a convergent-beam sensor's energy is concentrated at its focus, its maximum available excess gain is much higher than for other proximity modes. This relatively high excess gain allows the detection of materials of very low reflectivity, where diffuse-, divergent-, fixed-field-, and adjustable-field-mode sensors would fail. The effect of an object's relative reflectivity is most noticeable in the size of the resulting depth of field. And because the effective beam is so small, even objects with narrow profiles can return a relatively high percentage of the incident light.

Excess Gain and Sensor Alignment

The most common mistake made when installing infrared (invisible light) LED sensors is failing to center the light beam on its receiver or target. An installer often will adjust a sensor's position just until the alignment indicator LED lights or until the output load switches. This method likely results in only marginal alignment, with little excess gain available to overcome dirt build-up or other sensing variables. And while most photoelectric sensor lenses are accurately placed, it is not safe to assume that perfect mechanical alignment is exactly equivalent to the best optical alignment.

The excess gain indicator provides the easiest and best way to optimize sensor alignment and to monitor sensor performance on most sensors. Depending on the sensor, excess gain can be decreased in one of several ways to make the alignment status more apparent. In most opposed and retroreflective sensing applications, more accurate alignment can be accomplished using one of two simple methods.

If the sensor has a sensitivity (gain) control, temporarily adjust the receiver gain downward so that improved alignment registers a discernible difference on the signal strength indicator.

If the sensor has no sensitivity control, temporarily mask the lens(es) with layers of paper or paper tape to attenuate the signal strength. (If totally covering the lens yields too much attenuation, then unmask the very center of the lens. In retroreflective sensing, the retro target may be masked with only a small amount of the center area exposed.) Lens masking may be used in conjunction with temporary sensitivity reduction for accurate alignment in short-range opposed sensing where excess gain is very high.

Contrast

Other than analog measurement applications, photoelectric sensing involves differentiating between two levels of received light. Contrast is the "light-to-dark ratio" of the amount of light falling on the receiver in the "light" state, compared with the "dark" state. Contrast may be expressed by the equation:

$$\text{Contrast} = \frac{\text{Light level at the receiver in the light condition}}{\text{Light level at the receiver in the dark condition}}$$

It is always important to choose a sensor/lensing option that will optimize contrast for the particular sensing situation. Many applications, such as a cardboard box breaking a retroreflective beam, have extremely high contrast ratios. In such high-contrast applications, sensor selection simply involves verifying the existence of enough available excess gain for reliable operation under the sensing conditions.

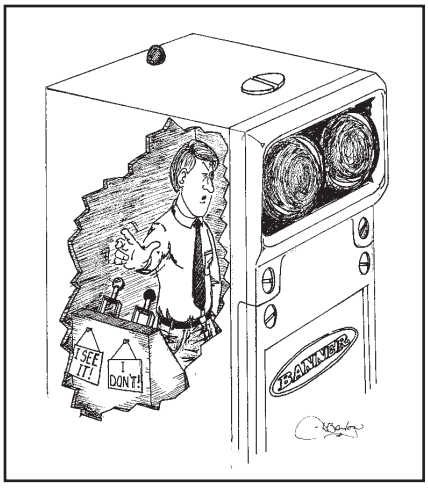


Figure 50. All photoelectric sensing applications involve differentiating between two received light levels

However, many of today's industrial photoelectric sensing applications are not so straightforward. Most problems with contrast in opposed and retroreflective applications occur when:

1) the beam must be blocked by a translucent or transparent material, or

2) only a portion of the effective beam is blocked.

For proximity-mode sensors, low-contrast problems occur when a close-in background object is directly in the scanning path. This is compounded when the background object's reflectivity is greater than the target object's reflectivity. Fixed-field, adjustable-field, or ultrasonic proximity mode sensors often can solve this problem.

As a general rule, a contrast of 3 is the minimum for any sensing situation. This is usually just enough to overcome the effect of subtle variables that cause light level changes, such as small amounts of dirt build-up on the lenses or inconsistencies in the product being sensed. Table 3 suggests guidelines for contrast values.

Contrast	Recommendation
1.2 or less	***Unreliable:*** evaluate alternative sensing schemes.
1.2 to 2	***Poor contrast:*** consider sensors with *Expert* programming
2 to 3	***Low contrast:*** sensing environment must remain clean and all other sensing variables must remain stable.
3 to 10	***Good contrast:*** minor sensing system variables will not affect sensing reliability.
10 or greater	***Excellent contrast:*** sensing should remain reliable as long as the sensing system has enough excess gain for operation.

Table 3. Contrast values and corresponding guidelines

Close-Differential Sensing

Some applications offer a contrast of less than 3, regardless of the sensing method used. These low-contrast situations fall into the category of close-differential sensing. Most color-registration applications qualify as close-differential sensing. Another common close-differential situation involves breaking a relatively large effective beam with a small part, as in ejected small-part detection or thread-break detection.

Color Registration Mark Sensing

Color registration mark applications require the sensor to differentiate between two colors which may be similar in hue and reflectivity. The most modern sensors tackle this challenge in two ways: with programmed sensor setup technology and by offering a choice of light beam colors to optimize the sensing contrast.

Figure 51. Beam color is an important consideration for color-mark sensing

Beam color can be important: a red LED does not see red marks on white, but sees blue and green. A blue LED sees green and red, but not blue. A green LED sees red and blue, but not green. Visible white LEDs solve a wide variety of sensing applications. When the proper light source color is selected for an application, even very small color differences can be detected.

Expert™ Sensors

Some new sensors can be programmed easily to differentiate between slight levels of contrast for demanding applications. Using "TEACH-mode" setup, the sensors can be taught to "look for" a window of acceptable conditions, or a set-point threshold (the light condition on one side of the threshold, and the dark condition on the other).

TEACH mode is a step-by-step sequence in which two sensing reference points (light and dark) are taught to the sensor, often using a push button. The sensor circuitry then automatically sets its sensitivity (expanding its low-end range, if necessary) to an optimal level.

Measuring Contrast

Sensors today fall into three main categories, with respect to sensitivity adjustment:

- those with no sensitivity control,
- sensors with mechanical sensitivity adjustment, and
- sensors with microcontrollers.

Sensors without sensitivity controls are popular for OEM use. They should be used only in stable situations where high contrast is assured, and when the sensor is known to offer enough excess gain to easily survive the operating conditions. Sensors with mechanical adjustment may be used in a much wider variety of applications, and those with microcontrollers (*Expert* sensors) can be adjusted to sense in situations where contrast is quite low, if other sensing variables remain constant.

Figure 52. Sensors without sensitivity controls should be used only in high-contrast applications

Figure 53. Marginal contrast may be verified by noting the differential between sensitivity settings for light and dark thresholds

Figure 54. Teachable sensors with microprocessors are useful when contrast is low

Contrast may be calculated if excess gain values are known for both the light and the dark conditions:

$$\text{Contrast} = \frac{\text{Excess gain (light condition)}}{\text{Excess gain (dark condition)}}$$

The most reliable sensor configuration will register maximum excess gain for the light condition, and no excess gain in the dark condition. In such high-contrast situations, it is important to select a sensor that provides this configuration. In the best circumstances, the gain can be adjusted to its maximum setting while the dark condition results in no indicator response. A contrast of 3 is typically represented by approximately one-third of an adjustable sensor's sensitivity control.

Some sensors are programmable for hysteresis. Switching hysteresis is an electronic design parameter that requires the signal level (the amount of received light) at the operate (turn-on) point of an amplifier to be different from the signal level at the release (turn-off) point. This differential prevents the sensor's output from "buzzing" or "chattering" when the received signal is at or near the amplifier threshold.

Most sensing is done using a normal hysteresis setting. A low hysteresis setting allows a sensor to be used for some poor-contrast (1.2 to 2) sensing applications. Sensing conditions must remain perfectly stable for such small contrasts to be reliably sensed.

Some sensors have an alarm that warns of low contrast. Flashing LEDs or displays may indicate whether gain is too high or too low, or if the contrast is too low. A dedicated alarm output in some sensors will further warn of inadequate contrast.

Contrast should always be considered when choosing a sensor, and should be maximized via alignment and gain adjustment during sensor installation. Optimizing the contrast of any photoelectric sensing application will always increase the sensing reliability.

However, it is possible for excess gain to be too high. A common example is a paper-web-detection application. While opposed sensors provide the best sensing contrast, they may offer so much excess gain (10,000x, or more!) that they "see" right through the paper. In such cases, it may be necessary to mechanically attentuate the light energy by intentionally misaligning the sensors or by adding apertures to one or both lenses. It is always best to attenuate the light energy so that the operating sensitivity setting is near the midpoint of the gain adjustment range.

Sensor Outputs

A sensor's output may be either discrete or analog. A discrete (or "switched" or "digital") output has only two states: on and off, based on the status of the load being controlled (Figure 55). The load might be an indicator light, an audible alarm, a clutch mechanism, a solenoid valve, or a switching relay; or it might provide input to a timer, a counter, or a programmable logic controller. Some sensors offer output logic as an optional feature, in the form of a plug-in module or timing board. Typical logic functions offered are ON-delay, OFF-delay, ON/OFF delay, one-shot and delayed one-shot.

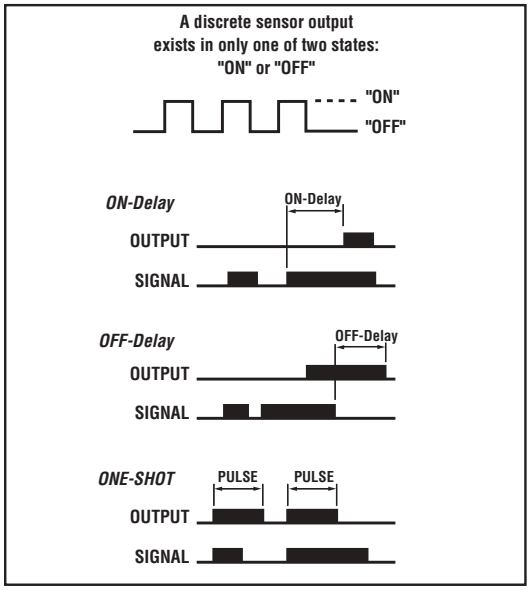


Figure 55. Discrete sensor output options

An analog output (Figure 56) varies over a range of voltage or current and is proportional to the strength of the received signal. An analog ultrasonic proximity sensor's output is proportional to the distance between the sensor and the object returning a sound echo, based on the time required for the echo to return to the sensor.

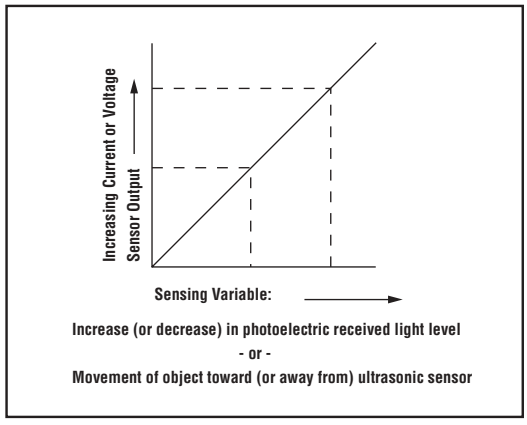


Figure 56. Analog sensor output

Analog outputs are useful in many process-control applications, where an object's position, size, or translucency is being monitored. Analog outputs also can provide a continuously variable control signal for another analog device, such as a motor speed control.

Light and Dark Operate

In photoelectrics, the sensing event (input) and the switched output state may be configured for light operate or dark operate. Some sensors can function only in light operate or in dark operate mode, depending on the sensor model. Others have a light/dark operate select switch. A sensor set for light operate will energize its output when the receiver "sees" more than a set amount of light; in dark operate it will energize its output when its receiver is sufficiently dark.

In opposed-mode sensing (Figure 57), dark operate means that the output energizes when an object is present (breaking the beam). In light operate, the output energizes when the object is absent. In retroreflective sensing, the conditions are the same (the dark condition occurs when the object is present, and the receiver sees light when the object is absent).

In proximity sensing modes, these conditions are reversed (Figure 58). The light condition occurs when the object is present and "making" (establishing) the beam. When the object is absent, no light is returned to the receiver.

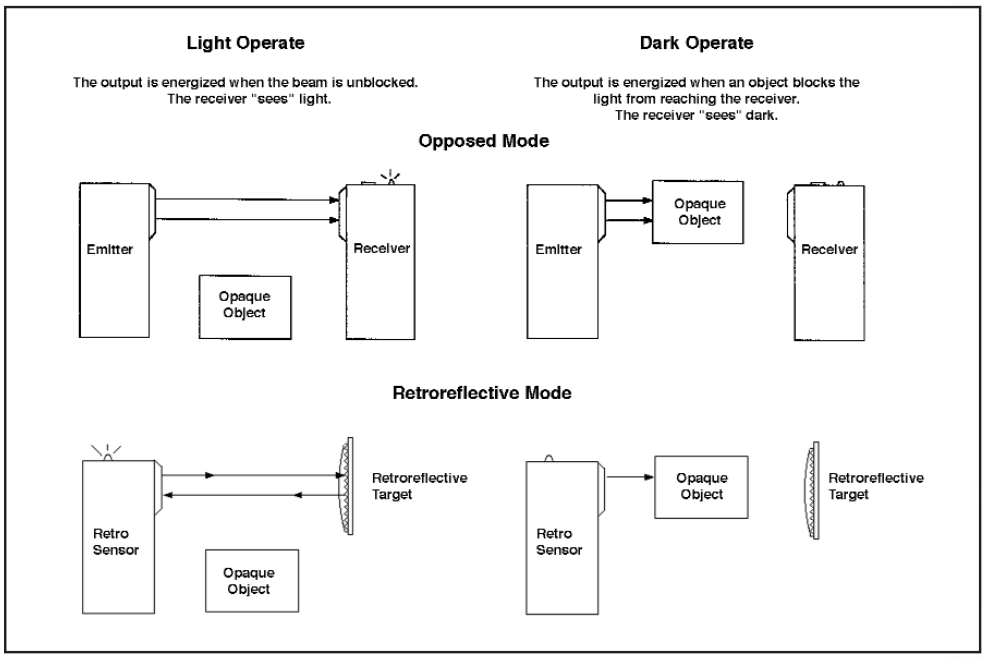


Figure 57.
Light- and dark-operate for opposed and retroreflective mode

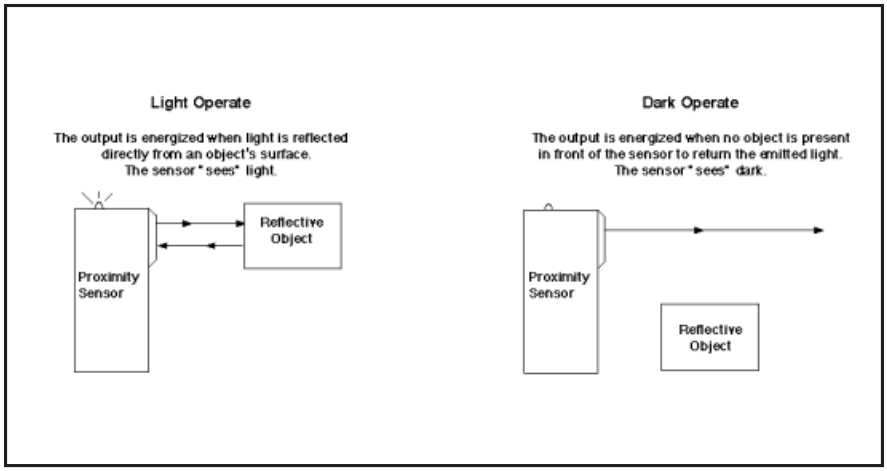


Figure 58.
Light- and dark-operate for photoelectric proximity modes

Response Time

Every sensor has a specified response time, the maximum time required for it to respond to a change in the input signal (such as a sensing event). It is the time between the leading (or trailing) edge of the sensing event and the output's change of state.

With a switched output, the response time is the time required for the output to switch (off-to-on or on-to-off); these two times are not always equal.

With an analog output, the response time is the maximum time required for the output to swing from minimum-to-maximum or from maximum-to-minimum. Again, these two times are not necessarily equal.

Response time is not always an important specification. For example, sensors that detect boxes passing on a conveyor do not require fast response. In fact, time delays are sometimes added to extend sensing response to avoid nuisance trips or to add simple timing logic for flow-control applications.

Response time becomes critical when detecting high-speed events, and especially when detecting small objects moving at high speed. Narrow gaps between objects or brief intervals between sensing events also must be considered when determining the required response speed.

Required Sensor Response Time

The required sensor response time may be calculated for an application when the size, speed, and spacing of the objects to be detected are known:

$$\text{Required Sensor Response} = \frac{\text{Apparent object width as it passes the sensor}}{\text{Object speed as it passes the sensor}}$$

For example, consider an application in which seed packets on a conveyor are counted by a convergent beam sensor (Figure 59). The following is known:

1) The packets are processed at a rate of 600/minute.
2) The packets are 75 mm wide.
3) The packets are equally spaced with about 25 mm separation between adjacent packets.

To compute the required sensor response time, the processing rate is first converted to packet speed:

600 packets/minute = 10 packets/second

Each packet accounts for:

75 mm (packet width) + 25 mm (space) = 100 mm of linear travel

Packet speed = 100 mm/packet x 10 packets/sec. = 1 m/sec.

The time during which the sensor "sees" a packet is:

$$\text{Time in light condition} = \frac{\text{object width (75 mm)}}{\text{object speed (1 m/sec.)}} = 0.075 \text{ sec. (or 75 ms)}$$

(time of each packet passing the sensor)

In this application, the time between adjacent packets is much less than the time during which the sensor "sees" a packet. As a result, the dark (or "off") time between packets is most important to consider:

$$\text{Time in dark condition} = \frac{\text{space width (25 mm)}}{\text{object speed (1 m/sec.)}} = 0.025 \text{ sec. (or 25 ms)}$$

(time of each space passing the sensor)

A sensor with a response time of less than 25 milliseconds will work in this counting application. However, it is wise to choose a sensor with a somewhat faster response time, as a safety factor.

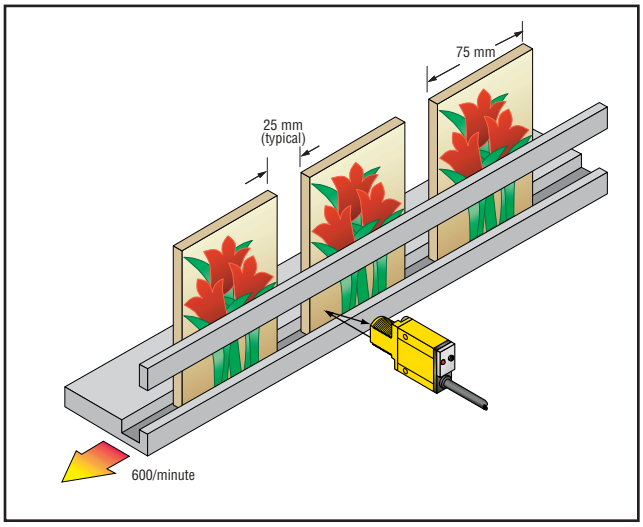


Figure 59. A convergent-beam sensor counts seed packets on a conveyor

Response Requirements for Rotating Objects

When sensing a rotating object, the calculation for the required sensor response time is the same. The only additional calculation is conversion of rotational speed to linear speed. For example, calculate the required sensor response time for sensing a retroreflective target on a rotating shaft, given the following information:

1) The target is a 25 x 25 mm square piece of retroreflective tape on a 160 mm diameter shaft.
2) Maximum shaft speed is 600 revolutions/minute (10 revolutions per second).

To convert rotational speed to linear velocity:

$$\text{Shaft circumference} = \pi \times \text{diameter} = \pi \times 160 \text{ mm} = 0.5 \text{ m}$$

$$\text{Linear velocity} = 0.5 \text{ m/revolution} \times 10 \text{ revolutions/sec.} = 5 \text{ m/sec.}$$

The required sensor response time is:

$$\text{Time in light condition} = \frac{\text{target length (25 mm)}}{\text{linear speed (5 m/sec.)}} = 0.005 \text{ sec. (or 5 ms)}$$

(time sensor "sees" retro tape)

Five milliseconds is the fastest response required for this application, because the untaped portion of the circumference is 19 times longer. A retroreflective sensor with a small effective beam and a response time faster than 5 milliseconds (such as a MINI-BEAM®) will reliably sense the tape at the maximum shaft speed. To ease the response time requirement in applications that require only one pulse per revolution (or per cycle), the target should cover half of the shaft circumference so that half the revolution is "light time" and the other half is "dark time."

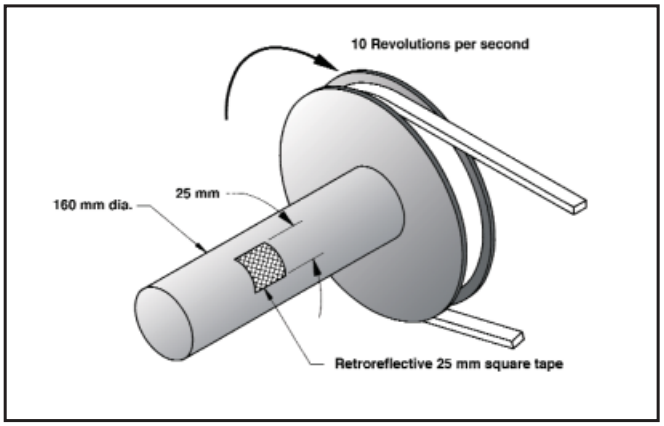


Figure 60. Calculating response time for a rotating component

Response Time Requirements for Small Objects

A safe assumption to make when calculating required response time for an object with a small cross section is that the object must fill all of the sensor's effective beam to be detected. Whenever the size of a small object begins to approach the size of the effective beam, the apparent size of the object as "seen" by the sensor becomes less than the actual width of the object. In these situations, reduce the apparent size of the object by an amount equal to the diameter of the effective beam at the sensing location. As a result, the required response time decreases:

$$\text{Required response time} = \frac{\text{Width of object - Diameter of effective beam}}{\text{Speed of the object through the beam}}$$

To illustrate the effect of small target objects on required response time, consider the example of a small pin that breaks the beam of an opposed sensor pair (Figure 61):

1) 8 mm diameter pins pass through the beam of an opposed emitter/receiver pair with a 4 mm diameter effective beam.
2) Maximum speed of the pins is 250 mm per second.

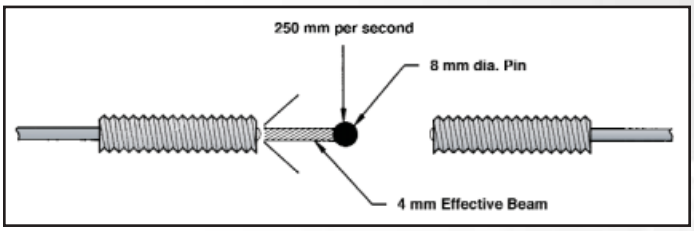


Figure 61. An 8 mm diameter pin is sensed in a 4 mm diameter effective beam

Computing the required sensor response time:

$$\text{Time of dark condition} = \frac{\text{Pin dia. (8 mm) – Effective beam dia. (4 mm)}}{\text{Speed of the pin through the beam (250 mm/second)}}$$

$$= \frac{4 \text{ mm}}{250 \text{ mm/sec.}}$$

$$= 0.016 \text{ sec. (16 ms)}$$

Adding apertures to the emitter and receiver lenses (Figure 62) eases the response time requirement (the pin will block the smaller effective beam for a longer time). If 1 mm diameter apertures are used:

$$\text{Time of dark condition} = \frac{8 \text{ mm} - 1 \text{ mm}}{250 \text{ mm/second}} = \frac{7 \text{ mm}}{250 \text{ mm/sec.}} = 0.028 \text{ sec. (28 ms)}$$

Due to resulting low excess gain, it is usually impractical to aperture an opposed beam to less than 0.5 mm. Cross sections smaller than 1 mm usually are sensed most reliably using a proximity sensing mode; the wider the beam, the longer a small part will be sensed, easing the sensor response requirement. Divergent-beam sensors, bifurcated fiber-optic sensors, or laser sensors are preferred for sensing very small profiles.

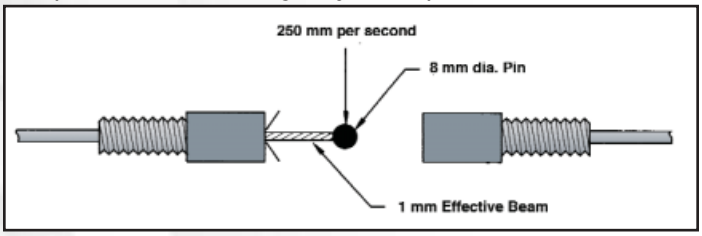


Figure 62. Required sensor response time is eased by the use of apertures

To sense narrow gaps, opposed-mode sensors should have a wide beam so that light is seen through the gap as long as possible. Individual fiber optics with a rectangular sensing tip can shape the effective beam, also easing sensor response requirements. When sensing narrow gaps with a proximity sensor, the small effective beam of a convergent mode sensor is preferred.

Response Time of a Load

The response time of a load (the device switched by the sensor's output) is the maximum time required to energize and/or de-energize the load; it is one of the load's specifications. In general, solid-state loads (counters and solid-state relays) have faster response times than electromechanical devices (solenoids and contactors).

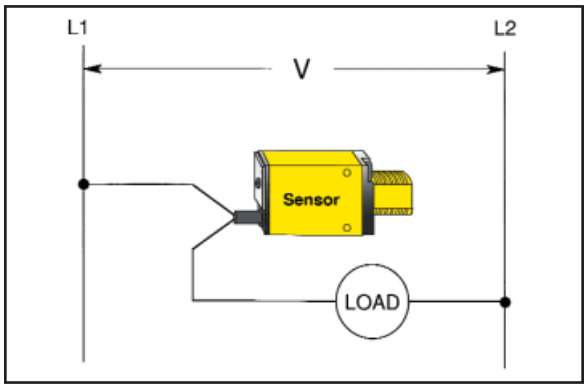


Figure 63. The response time of any load is included in its specifications

The response speed characteristics of any load to be controlled should be checked to be sure that the duration of the sensor's output signal and the time between adjacent outputs are sufficient to allow the load to react properly. If the load is too slow to react, a delay timer may be required between the sensor output and the load to extend the duration of the sensor's output signal. A better solution involves changing the sensing geometry, if possible, to equalize the durations of the light and the dark (on and off) times.

Repeatability of Response

Sensor repeatability becomes important whenever a sensing event is used to trigger an action, especially in high-speed, cyclical operations. Examples include sensors that trigger glue striping (on box flaps or envelopes), ink-jet printing (product date code imprinting), and label registration. In these examples, the sensor's response repeatability helps provide consistent product appearance.

Repeatability of response is easily defined for most modulated photoelectric sensors. Today's digital modulation schemes count a defined number of received light pulses before responding to any light signal. This helps the sensor discriminate between its emitter's light and other interfering signals.

Typically, the sensor's output is allowed to switch only after three or four modulated light pulses are counted. The response time before a modulated sensor turns on is equal to the time required for the sensor to count (demodulate) that number of pulses, and the sensor output changes state as soon as the sensor counts enough light pulses of the correct frequency. However, since the sensing event can occur at any time during a modulation cycle, the actual time between the sensing event and the sensor's output change can vary by up to one modulation cycle (see Figure 64). This sensing response variation is the sensor's repeatability.

The sensor repeatability specification is multiplied by the velocity of the sensed object to determine the mechanical repeatability (the amount of mechanical error) due to the sensor response. For example, assume that the sensor shown in Figure 59 is triggering an ink-jet printer to imprint a date code on the seed packets. The variation in placement of the printing along the direction of travel is calculated:

- Velocity of seed packets = 1 m/second
- Sensor repeatability = 0.3 ms = 0.0003 seconds (typical value)
- Mech. repeatability = 1 m/sec. x 0.0003 sec. = 0.3 mm (due to sensor)

The date code placement error factor for each seed packet does not take into account the repeatability of the other control elements. (Here, the control circuits for the ink-jet printer head and for the printer mechansim itself each will contribute to the total variation in the location of the imprint.)

The sensor's repeatability specification is based on the transition from dark to light. Counting of modulated light pulses is not considered for each light-to-dark transition. Repeatability for dark-operated outputs is not specified; however, it is a much briefer time than the repeatability specification for dark-to-light (typically less than 10% of the specified "off" response time). The sensor repeatability specified is a "worst case" value, which can be relied upon when evaluating high-speed applications where repeat accuracy is important.

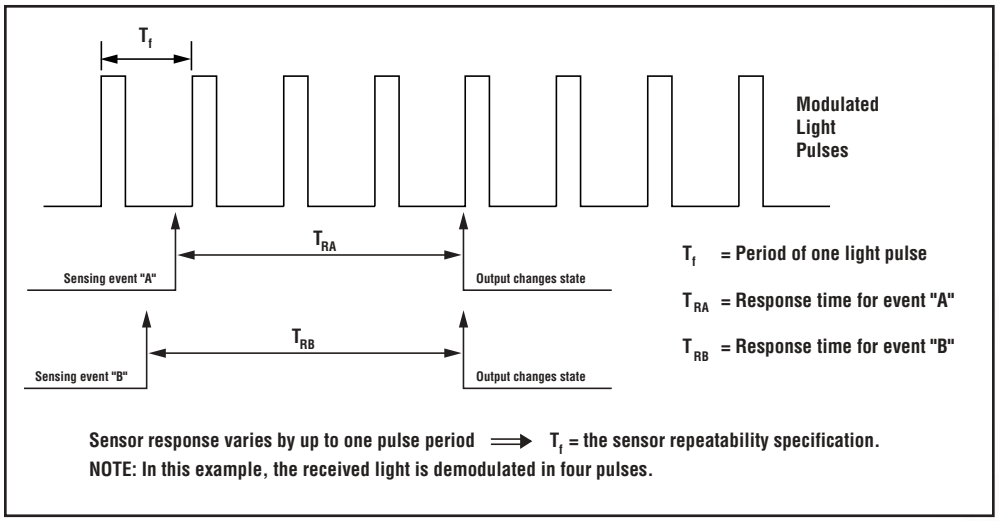
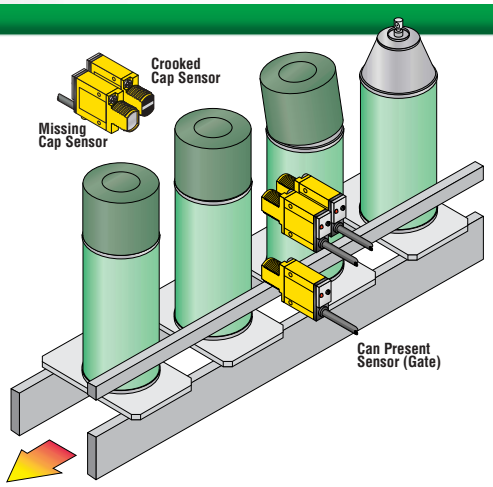


Figure 64.
The repeatability of a modulated photoelectric sensor is equal to the period of one light pulse

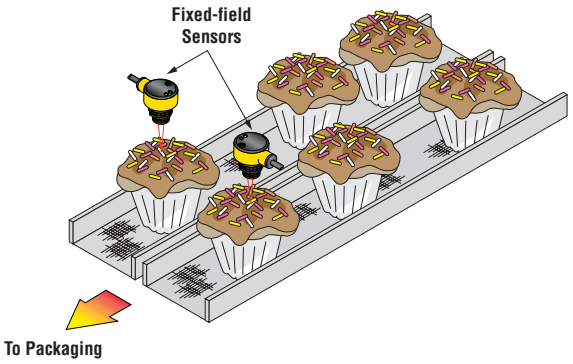


Spray Can Inspection

Application: Inspect spray cans with crooked or missing caps.

Sensor Models: Two pairs of MINI-BEAM SM31E and SM31R opposed mode sensors, and one MINI-BEAM SM312CV convergent mode sensor.

Application Notes: The convergent sensor provides a gate signal for one of the two opposed mode receivers which checks for a missing cap. The other opposed mode pair is fitted with rectangular apertures to sense any excess can height caused by a crooked cap.

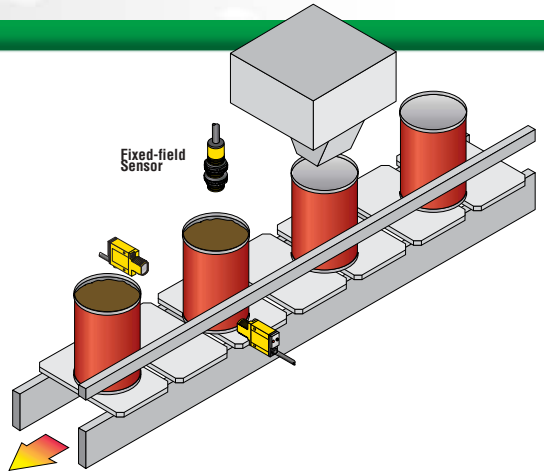


Sensing Baked Goods on a Conveyor

Application: Sense baked goods on adjacent, parallel flat conveyors.

Sensor Models: Two EZ-BEAM T18SP6FF50 fixed-field sensors.

Application Notes: Fixed-field technology permits reliable proximity-mode sensing of irregularly shaped objects, while ignoring background surfaces such as the conveyor.

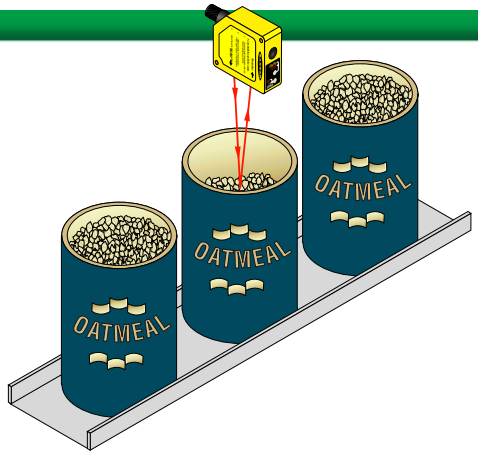


Fill Level Inspection

Application: Inspect for proper fill level of coffee in cans, before sealing.

Sensor Models: EZ-BEAM S18SN6FF50 fixed-field mode sensor; MINI-BEAM SM31E and SM31R opposed mode sensor pair.

Application Notes: The MINI-BEAM opposed mode pair is used to gate the EZ-BEAM fixed-field sensor when the leading edge of a can blocks the opposed beam. The EZ-BEAM fixed-field sensor offers enough excess gain inside of its 50 mm cutoff point to sense dark materials, such as coffee, which have low reflectivity.

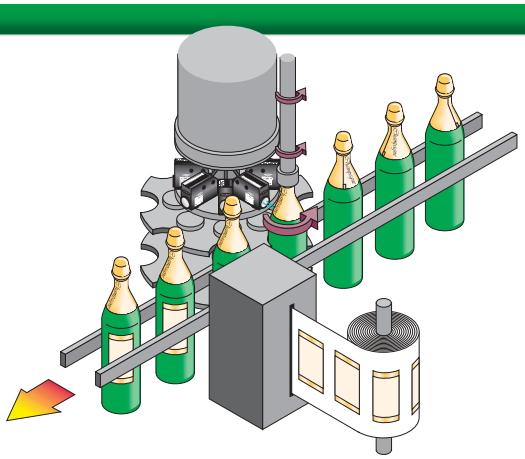


Fill Level Control

Application: Monitor and control fill level of dry cereal in a packaging operation.

Sensor Models: L-GAGE® model Q50BU.

Application Notes: Many food processing lines now fill by level, instead of by weight. Infrared analog Q50 sensors are the best choice for fill level monitoring of irregular surfaces, such as dry cereals.

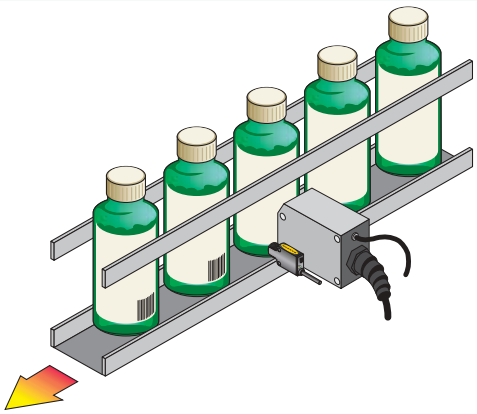


Product Orientation

Application: Position bottle so that the top label (already applied as a foil wrap) consistently lines up with the bottom label.

Sensor Model: R55CG1 color mark sensor.

Application Notes: Each bottle is indexed into position and rotated until the color mark on the foil wrap is sensed. The bottle is then moved to the label applicator.

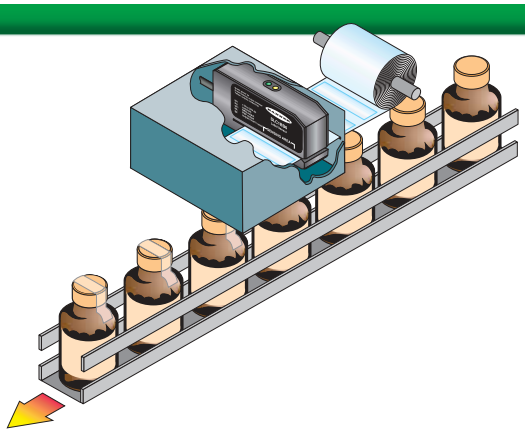


Ink Jet Printing Registration

Application: Sense the leading edge of bottles and provide the trigger signal to an ink jet printer.

Sensor Model: QS12VN6CV10

Application Notes: Bottles are channeled through guide rails to control the distance to both the sensor and the ink jet printer. The convergent beam sensor consistently triggers the printer at the same point on the circumference of each bottle to provide accurate printing registration.



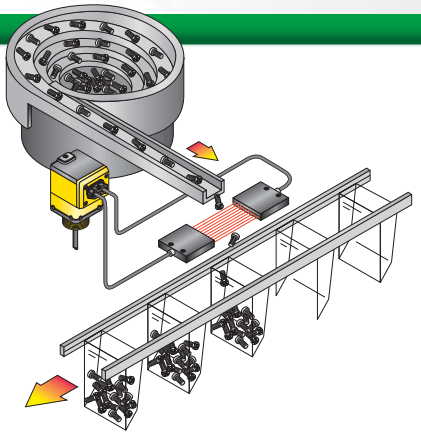
Tamper Proof Seal Application

Application: Accurately sense the leading or trailing edge of clear safety seals for application of the seals over bottle caps.

Sensor Model: C-GAGE® model SLC1BB6.

Application Notes: The SLC1 Label Sensor reliably detects the presence of most label types, including clear labels on either opaque or clear backing. Registration accuracy of ±0.3 mm (0.012") is typical at label web speeds of up to 1.5 m (60") per second. The sensor's Adaptive Digital Logic* (ADL™) provides self-learning capability. The SLC1 also provides continuous automatic internal adjustment of sensing threshold and drift compensation.

* U.S. Patent Pending

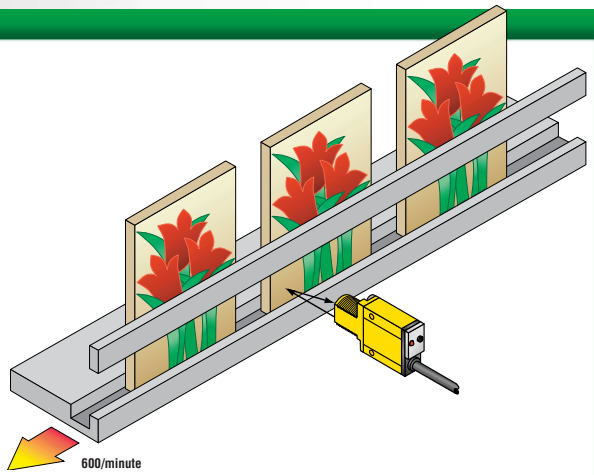


Small Parts Counting

Application: Count small parts fed by a vibratory feeder to fill bags.

Sensor Models: OMNI-BEAM model OSBFAC sensor head with model OPBT2 power block and OLM8M1 one-shot timing logic module; two IR2.53S rectangular glass fiber optic assemblies.

Application Notes: The two fiber optics are positioned across the end of the feeder track to count parts as they fall into a bag, below. The sensing window measures 75 mm (1.5") wide by the distance of separation between the fiber sensing ends. The OMNI-BEAM sensor's ac-coupled amplifier reliably senses the very small change in light signal produced by a falling part. The sensor's one-shot output pulse is supplied to the input of the counting logic used in the process.

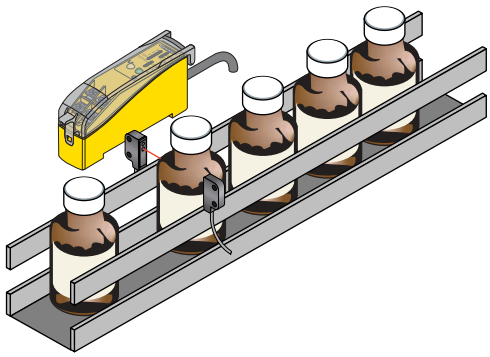


Product Counting

Application: Accurately count seed packets for order fulfillment.

Sensor Model: MINI-BEAM model SM312C.

Application Notes: This MINI-BEAM convergent mode sensor produces a powerful infrared beam which registers one "clean" count from each passing seed packet. Dark and light printed areas are sensed equally. The small convergent spot produced by this sensor reliably responds to the narrow spaces between adjacent packets.

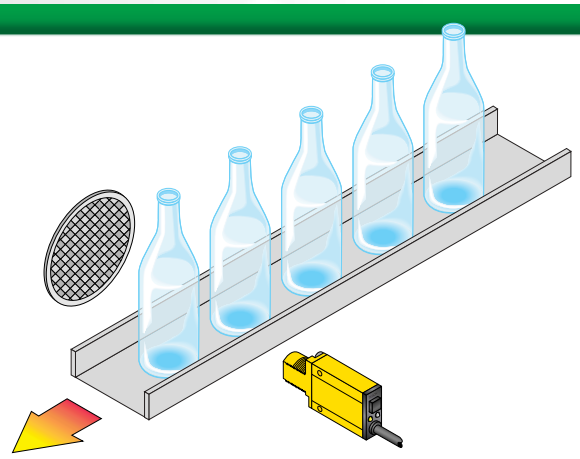


Bottle Counting

Application: Accurately count products in a packaging operation.

Sensor Models: PICO-AMP™ SP8ER1 opposed mode remote sensors and MD14BB6 amplifier module.

Application Notes: Count accuracy is one benefit of the opposed sensing mode. PICO-AMP sensors can often fit into tight locations which otherwise are too cramped for a pair of opposed mode sensors.

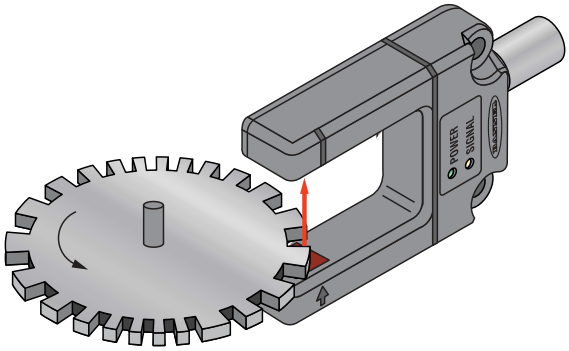


Clear Bottle Counting

Application: Accurately count clear bottles.

Sensor Model: MINI-BEAM *Expert*™ model SME312LPC Clear Object Sensor.

Application Notes: The polarized retroreflective optics of MINI-BEAM *Expert* clear object detection sensors are optimized for reliable sensing of clear glass or plastic materials. The sensor generates one solid count from each bottle moving through the beam.

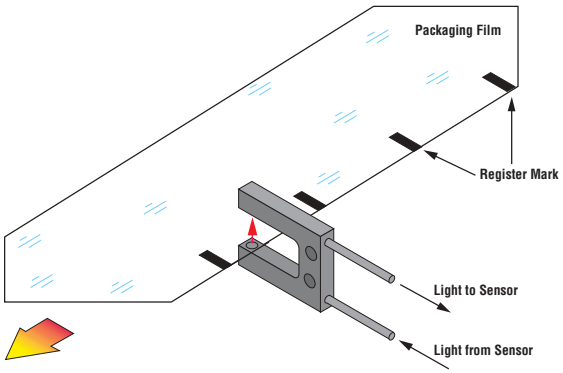


Gear Tooth Sensing

Application: Sense teeth of timing gear.

Sensor Model: SL30VB6V slot sensor.

Application Notes: SL Series slot sensors provide an economical way to reliably produce pulses from timing gears used in automated production machinery.

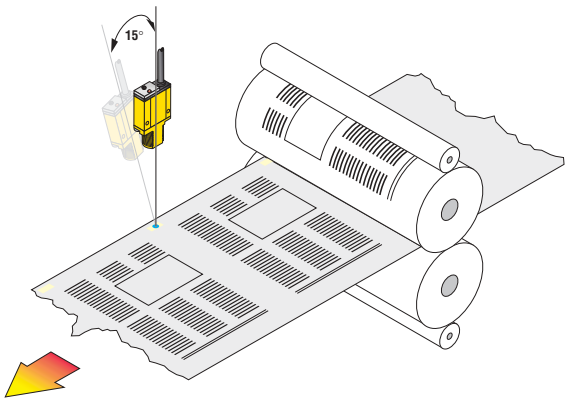


Clear Film Register Mark Sensing

Application: Detect a color mark printed along one edge of a continuous web of clear or translucent material to accurately control downstream cutoff.

Sensor Models: D11EN6FPG with plastic fiber optic assembly model PDIS46UM12.

Application Notes: This special plastic fiber optic assembly is terminated in a U-shaped slot sensor which straddles the web edge. This D11 *Expert*™ TEACH mode sensor model uses a visible green light source, which excels at opposed mode detection of lightly-printed registration marks on clear films. The opposed mode has the added advantage of being relatively insensitive to the color of the mark, and also to web "flutter".

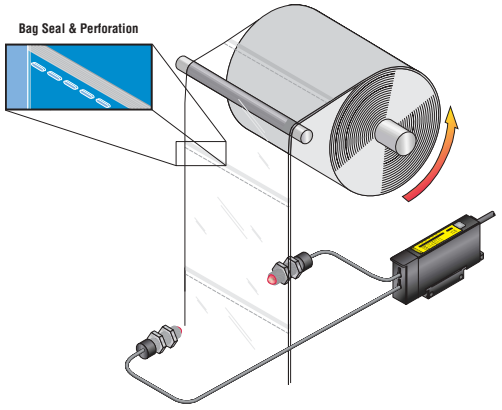


Web Cutoff Registration

Application: Detect a color mark printed along one edge of a continuous web to accurately control downstream cutoff.

Sensor Model: MINI-BEAM model SM312CV2B convergent blue color mark sensor.

Application Notes: This MINI-BEAM blue-LED convergent mode sensor reliably detects many difficult color mark contrasts, including yellow against off-white (shown here). The sensor is located near the printing drum where web "flutter" is not a factor. A 15° "skew" angle from perpendicular is used to avoid strong direct reflections from shiny materials.

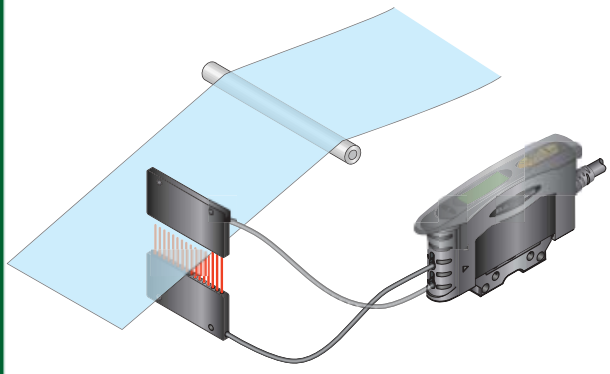


Clear Bag Separation

Application: Sense the perforations in a continuous clear web to trigger a separation mechanism.

Sensor Models: D12EN6FP *Expert*™ with a pair of PIL46U plastic fiber optics.

Application Notes: The low contrast capability of the *Expert* sensor, combined with the lensed plastic fiber optics, can detect perforations in clear materials.



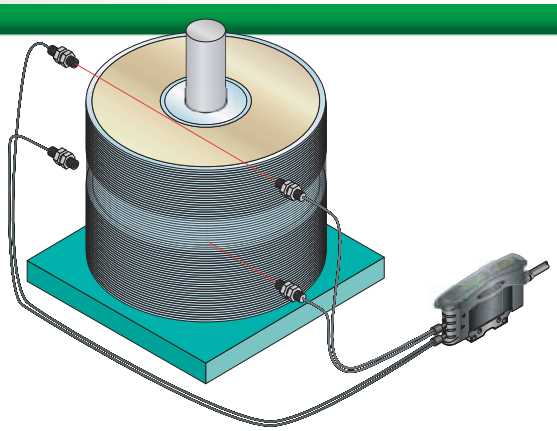
Analog Edgeguiding and Web Break Detection

Application: Provide an analog signal for edgeguiding of an opaque or semi-transparent web material, and provide an alarm for a web break.

Sensor Model: D10DNFP (with one analog and one discrete output).

Fiber Optic Model: One pair of model PIRS1X166UMPMAL 16-beam linear array individual plastic fiber optics.

Application Notes: The analog output of the D10 sensor provides a voltage which is proportional to the number of beams broken in the linear array by the web material. This analog signal is used for edge position control. The discrete output of the D10 is programmed to energize an alarm if no beams are blocked (indicating a web break).

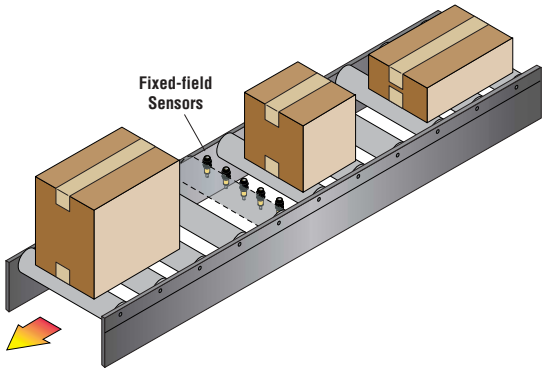


CD Stack Height Control

Application: Detect the height of a CD stack at two levels.

Sensor Model: D10DNFP

Application Notes: A CD duplication process "burns" 25 CDs per cycle. The two discrete outputs of the D10 sensor are programmed to output for half-stack and full-stack conditions (i.e., Output #1 energizes at 50% and Output #2 energizes at 100% beam blockage). When a half-stack (of 25 CDs) is sensed, the duplication machine is re-loaded and cycled. When a full stack of 50 CDs is sensed, the CDs are removed and packaged, and the process cycle restarts.

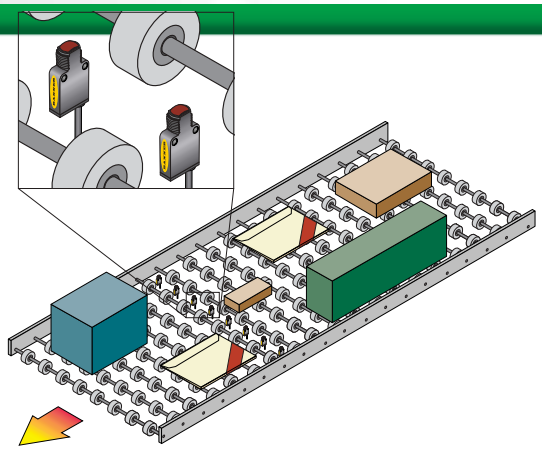


Box Sensing

Application: Sense boxes anywhere across a roller conveyor, where sensing is possible only from under the conveyor.

Sensor Model: Five EZ-BEAM model S18SP6FF100 fixed-field sensors.

Application Notes: The optics of this fixed-field sensor are ideal whenever sensing must be accomplished from underneath a conveyor. Excess gain is very high at the optimum sensing distance of about 25 mm (1"). Also, excess gain is low right at the lens of the sensor (at 0 mm or 0"). Therefore, sensor performance is not affected by moderate amounts of dirt and dust falling on the lens.

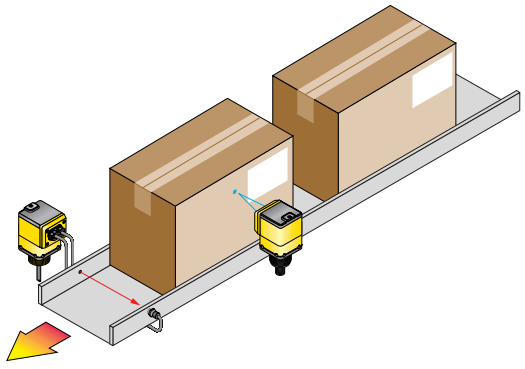


Parcel Sensing

Application: Sense random-sized parcels on a roller conveyor.

Sensor Model: QS12VN6CV20 (several sensors mounted across width of conveyor).

Application Notes: MINI-BEAM®2 sensors fit easily between conveyor rollers. The convergent optics are more forgiving than diffuse optics to the build-up of dust and dirt on the lenses.

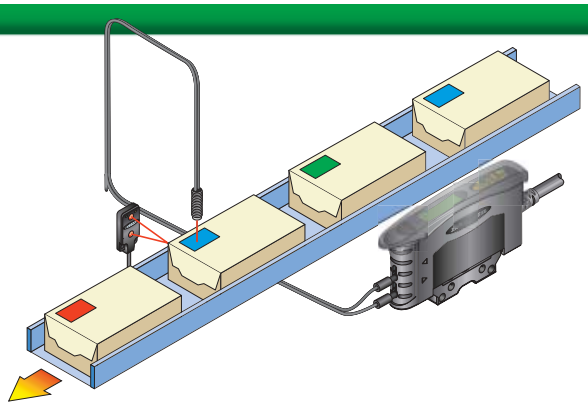


Label on Box Detection

Application: Detect the presence or absence of a white label on a corrugated kraft cardboard box.

Sensor Models: OMNI-BEAM model OSBCVB sensor head with OPBT power block; OMNI-BEAM model OSBFP with OPBT power block and a pair of PIL46U opposed mode plastic fiber optic assemblies.

Application Notes: OMNI-BEAM model OSBCVB converges the light from a blue LED source at 38 mm (1.5") to reliably sense a white label on a kraft cardboard box. A model OSBFP uses individual plastic fiber optics in the opposed sensing mode to gate the label sensor to check for the label when the leading edge of a box is sensed.



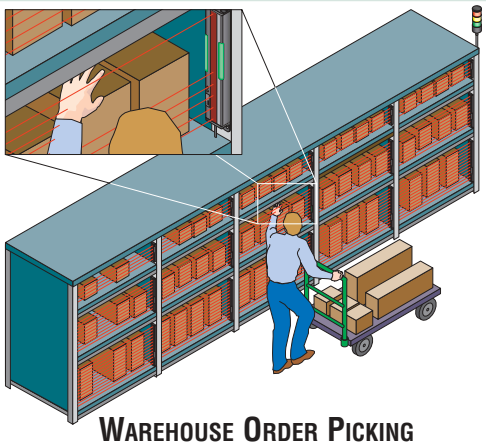
Color Sorting

Application: Sort cartons by color-coded labels.

Sensor Models:

Color Sensor: D10DNFP (with dual discrete outputs).
Interrogate Sensor: VS2AN5CV30 convergent beam.
Fiber Optic: Bifurcated model PBCT46U.

Application Notes: Three colored labels (red, blue and green) are used to sort cartons on a packaging line. The two outputs of the D10 are programmed as follows: red = both outputs ON, blue = both outputs OFF, and green = one output ON and other OFF. The outputs of the D10 are gated using a VS2 Series convergent mode sensor.

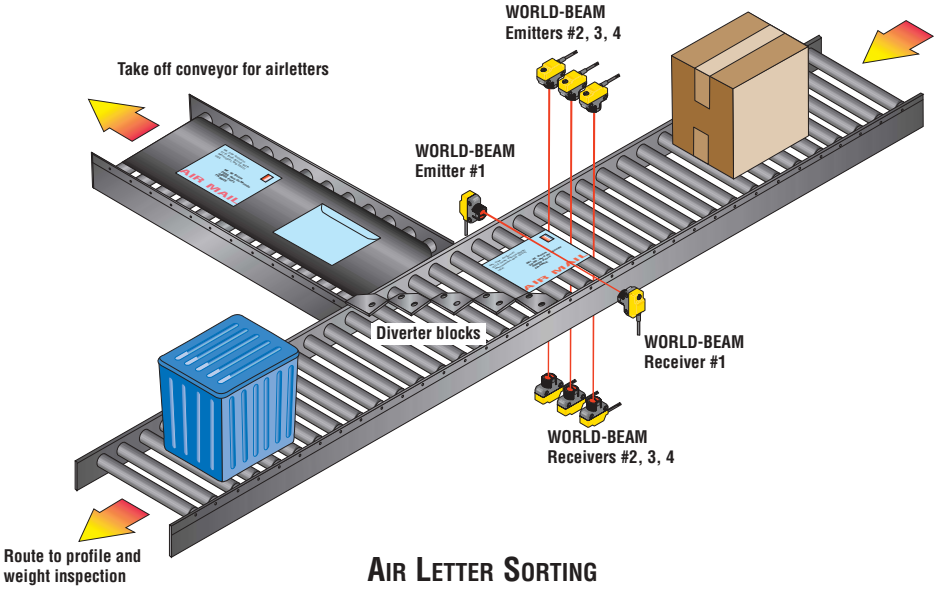


Warehouse Order Picking

Application: Indicate which bin to pick from, and verify that an item was removed.

Sensor Model: PVA Series emitter/receiver pairs–any of four lengths.

Application Notes: The system controller (typically a computer) issues an instruction to pick an item from a particular location. The controller turns ON the PVA's "job lights" at the specified location. The job lights go OFF when an item from that location is removed. If multiple items are required from one location, the job light stays ON until the correct number of items are removed.

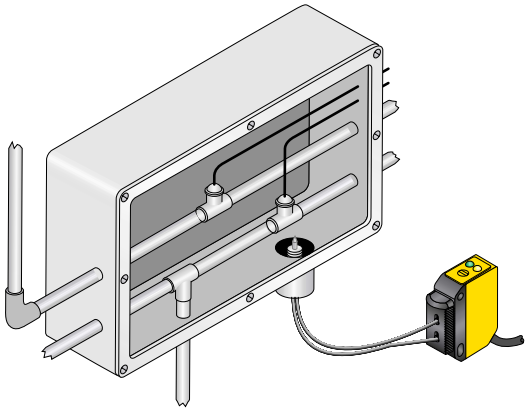


Air Letter Sorting

Application: Separate air mail letters from other parcels in an automated airfreight operation.

Sensor Models: (4) WORLD-BEAM QS186E and QS18VN6R opposed mode emitter and receiver pairs.

Application Notes: Three vertical opposed beams are equally spaced across the width of the powered roller conveyor, so that one or more of the beams is interrupted by any passing parcel. The fourth opposed beam is positioned horizontally across the width of the conveyor, at a height of 50 mm (2") above the rollers to inspect each parcel for height. If a parcel slips under the height inspection beam, the diverter mechanism is energized. The diverter blocks remain energized until a parcel exceeding 2" in height is detected.

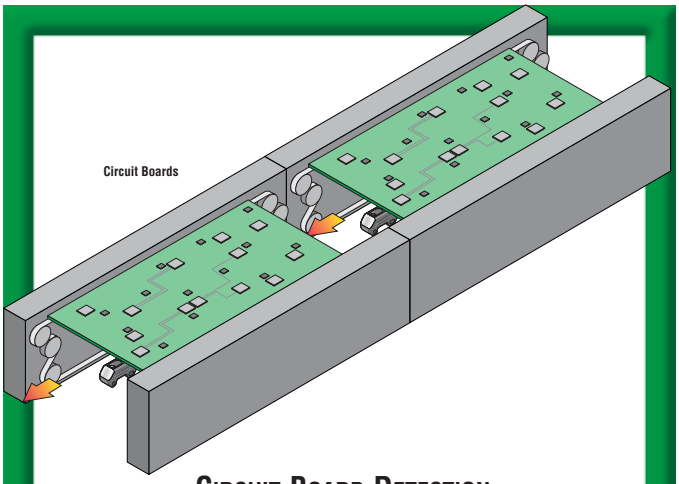


Leak Detection

Application: Detect a plumbing leak inside a valve box.

Sensor Models: Q23SN6FP; PBT46U plastic fiber optic assembly with TGR3/8MPFMQ liquid level probe.

Application Notes: Leak detection is required in a process which uses hazardous chemicals. A fiber optic liquid level probe immediately senses liquid present on the end of the probe tip. The Q23 sensor responds by triggering a warning alarm.

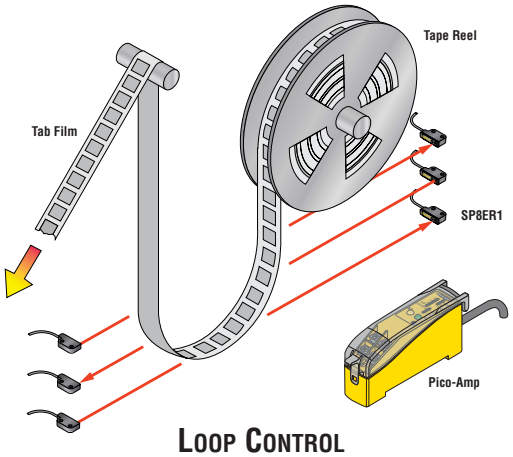


Circuit Board Detection

Application: Detect the leading edge of a printed circuit board on an indexing conveyor to stop circuit board movement.

Sensor Model: VS1AN5CV10

Application Notes: The VS1 Series convergent mode sensor is positioned under the conveying surface to sense the bottom of the printed circuit boards. The high excess gain at the sensor's convergent point makes the VS1 forgiving to any reflectivity variations of the circuit boards.

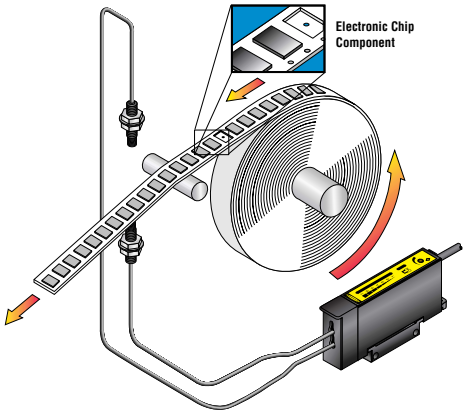


Loop Control

Application: Control the speed of a reel of surface mount circuit components, using loop control.

Sensor Models: Three pairs of opposed mode SP8ER1 emitters and receivers are used with three PICO-AMP model MD14BB6 amplifiers. NOTE: Only one amplifier is shown, but three are required (one per sensor pair).

Application Notes: The loop position is monitored by three opposed beams. Speed of the reel is regulated, relative to the number of beams interrupted by the loop. The MD14 amplifier offers different modulation frequencies to prevent optical crosstalk between closely spaced adjacent sensor pairs.

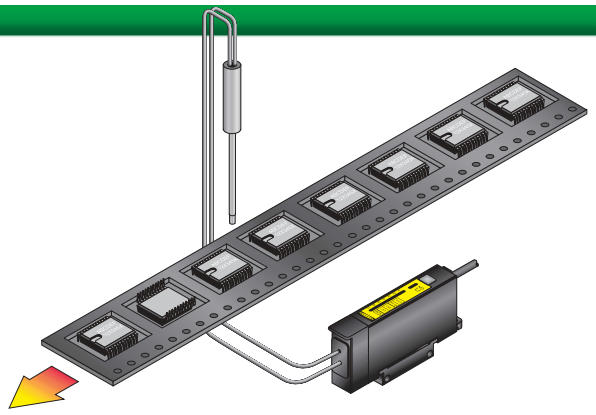


Missing Part Detection

Application: Detect missing surface-mount integrated circuits in plastic tape reels.

Sensor Models: D12SN6FP with a pair of PIT46U plastic fiber optic assemblies.

Application Notes: Surface mount integrated circuits are packaged in pockets on a plastic tape web. Holes in the base of each pocket are covered when a component is present. The fiber optic sensing ends are aligned with the holes. A missing part is detected when a light beam is established through the hole in the pocket.



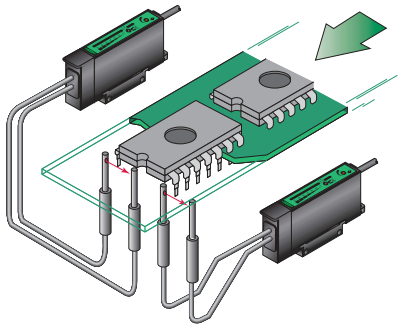
Inverted IC Chip Sensing

Application: Determine if an IC is improperly placed in a plastic pocket.

Sensor Model: D12EN6FP

Fiber Optic Model: PBEFP26U

Application Notes: Integrated circuits have identification information printed on their top surface; *Expert* sensors have the ability to "see" this printed side as a "light" condition. The bottom of the component reflects less light, allowing inverted components to be sensed.



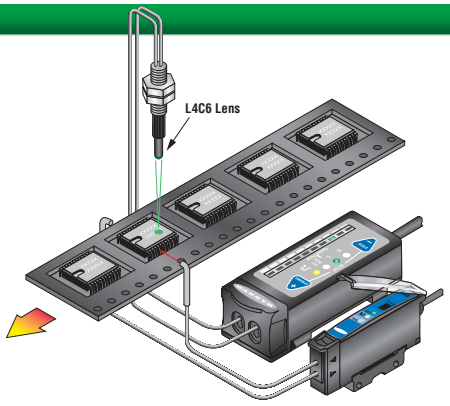
IC Lead Counting

Application: Count the leads on an integrated circuit.

Sensor Model: Two D12SN6FPY

Fiber Optic Model: Two pair PIPSM26U

Application Notes: Leaded integrated circuits are mounted on a circuit board. Before the leads are trimmed, the boards are inspected to ensure proper insertion of the IC into the board. Miniature "side view," opposed mode fibers are used to count the leads. Two pairs are used to sense both rows of leads simultaneously.



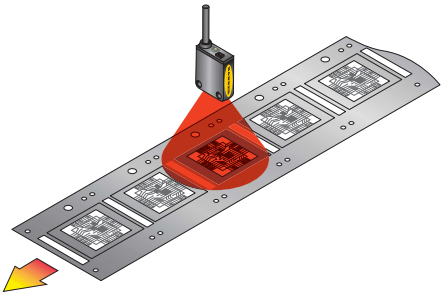
IC Print Verification

Application: Detect the presence or absence of information printed on a small object.

Sensor Model: R55FPG and D11EN6FP

Fiber Optic Model: PBCT26U and PIA26U (pair)

Application Notes: An R55F Series sensor is used with model PBCT26U plastic fiber optic cable and model L4C6 lens to inspect for small white printing on integrated circuits. The R55F is a "TEACH mode" sensor that "learns" the difference between the presence and absence of the printing, using push-button programming. The convergent lens is located 6 mm (0.24") away from the surface of the IC. The D11E uses individual plastic fibers in the opposed sensing mode to gate the R55F when the leading edge of the IC is sensed.

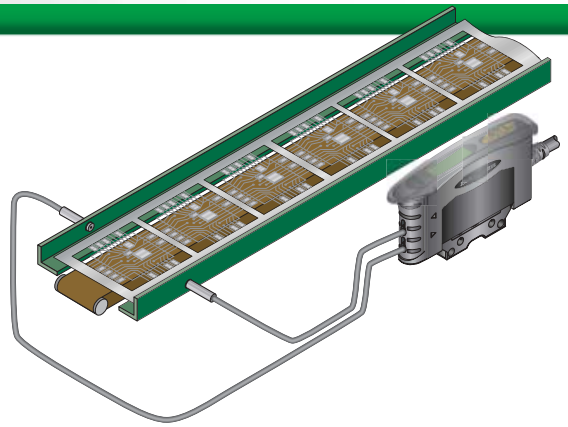


Lead Frame Detection – Divergent Diffuse Mode

Application: To detect the presence of an integrated circuit lead frame.

Sensor Model: QS12VN6W

Application Notes: The wide beam of the divergent optics senses the lead frame, even in areas where most of the metal is removed.



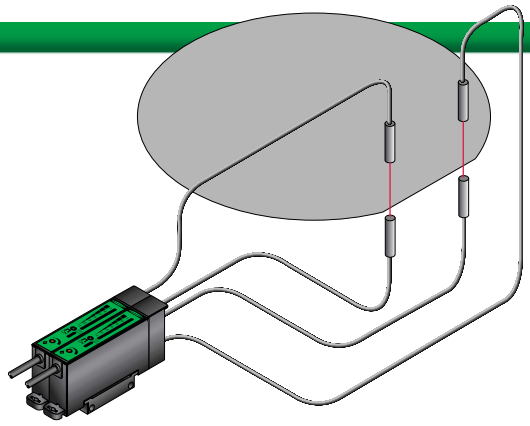
Lead Frame Detection – Opposed Mode

Application: Sense the presence of an integrated circuit lead frame.

Sensor Model: D10DNFP

Fiber Optic Model: One pair of model PIF26UMLS individual plastic fiber optics.

Application Notes: An integrated circuit lead frame moves in a U-shaped channel, and must be sensed using the opposed mode. Diffuse sensing is not possible, due to large differences in reflectivity of frame materials, plus a reflective background. The thickness of the lead frame material is 0.1 mm and the diameter of the beam is 0.5 mm. The D10 sensor is able to differentiate this low contrast.

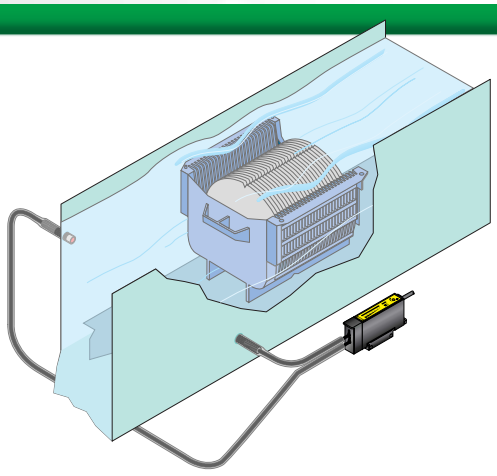


Wafer Positioning

Application: Position semiconductor wafers by locating the “flat”.

Sensor Models: Two D12SN6FPY sensors and two pairs of PIF26U individual fiber optics.

Application Notes: A semiconductor wafer is rotated in a positioning fixture. Rotation stops when the light beams of both opposed mode fiber optic sensors are established across the face of the wafer flat. High response speed (50 microseconds) D12 sensors are used to optimize stopping repeatability.

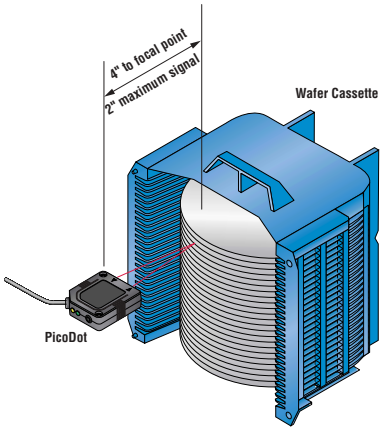


Wafer Cassette Sensing

Application: Sense the presence of a wafer cassette on a conveyor submerged in de-ionized water.

Sensor Models: D12SN6FP with a pair of PIE46UT plastic fiber optic assemblies.

Application Notes: Silicon wafers are transported from one process to another in a cassette, via a conveyor which is submerged in de-ionized water. Teflon-encapsulated opposed mode plastic fiber optics are located on opposite sides of the conveyor. The end tips of the fiber optic cables may be fully immersed in the water. The opposed mode beam is broken by the cassette, when it is present.



Wafer Cassette Mapping

Application: Locate each wafer in a cassette by detecting wafer edges.

Sensor Model: PicoDot® model PD45VN6C100.

Application Notes: PicoDot model PD45VN6C100 focuses a precise laser beam at 100 mm (4") from the sensor lens. However, to sense the very thin profile of a semiconductor wafer edge, the optimum sensing distance is about 50 mm (2"), where the beam spot size is larger and excess gain is higher.

Miniature Sensors

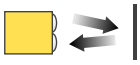
Miniature sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

VS1 Sensors

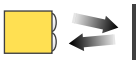
Miniature Convergent Mode Self-Contained Sensors

- Totally self-contained miniature sensors
- 10 to 30V dc operation
- High-quality, low-cost replacement for competitive miniature sensors
- Choose visible red or infrared sensing beam
- Choose models with 10 mm (0.4") or 20 mm (0.8") convergent point
- Choose dark or light operate models
- Choose models with NPN (sinking) or PNP (sourcing) output
- 3-wire hookup; output load capacity to 50 mA
- Choice of integral cable or pigtail quick-disconnect connector

VS1 Sensing Mode Options

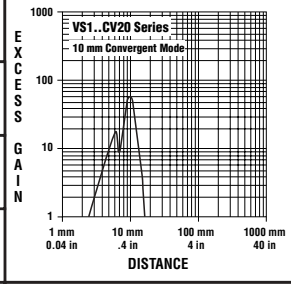
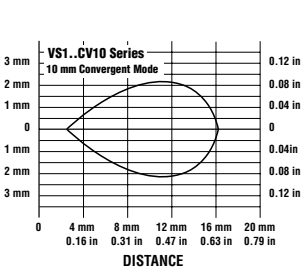
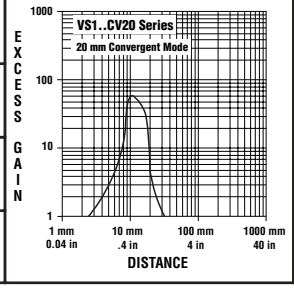
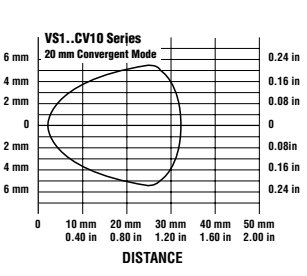


Convergent



Visible red, 630 nm

VS1 Series Convergent Mode - Visible Red

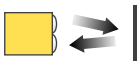
Models	Range*	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
VS1AN5CV10	10 mm (0.4") ±5 mm	2 m (6.5') 3-wire	10-30V dc	NPN/ LO		
VS1AN5CV10Q		3-Pin Pico-style Pigtail QD				
VS1RN5CV10		2 m (6.5') 3-wire		NPN/ DO		
VS1RN5CV10Q		3-Pin Pico-style Pigtail QD				
VS1AP5CV10		2 m (6.5') 3-wire		PNP/ LO		
VS1AP5CV10Q		3-Pin Pico-style Pigtail QD				
VS1RP5CV10		2 m (6.5') 3-wire		PNP/ DO		
VS1RP5CV10Q		3-Pin Pico-style Pigtail QD				
VS1AN5CV20	20 mm (0.8") ±10 mm	2 m (6.5') 3-wire		NPN/ LO		
VS1AN5CV20Q		3-Pin Pico-style Pigtail QD				
VS1RN5CV20		2 m (6.5') 3-wire		NPN/ DO		
VS1RN5CV20Q		3-Pin Pico-style Pigtail QD				
VS1AP5CV20		2 m (6.5') 3-wire		PNP/ LO		
VS1AP5CV20Q		3-Pin Pico-style Pigtail QD				
VS1RP5CV20		2 m (6.5') 3-wire		PNP/ DO		
VS1RP5CV20Q		3-Pin Pico-style Pigtail QD				

For VS1 Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **VS1AN5CV10 W/30**)

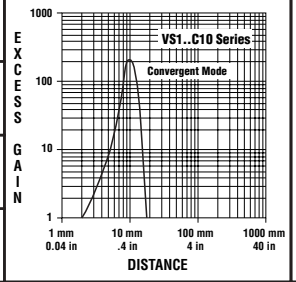
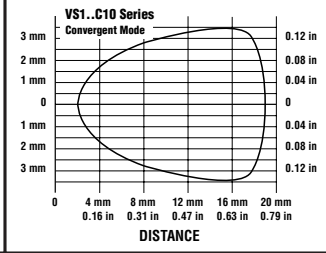
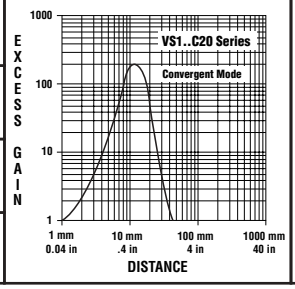
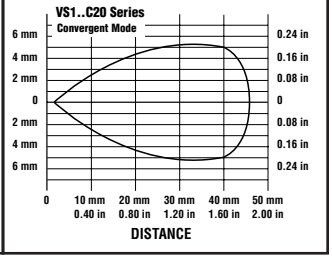
ii) A model with a QD connector requires an accessory mating cable. See page 62 and the Accessories section for more information.

*Performance based on 90% reflectance white test card

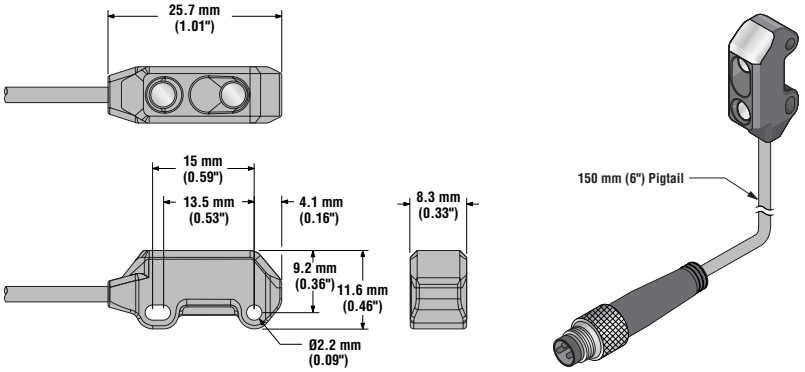


Infrared, 865 nm

VS1 Series Convergent Mode Sensors - Infrared

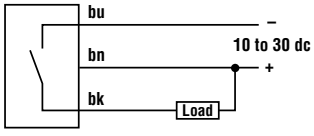
Models	Range*	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
VS1AN5C10	10 mm (0.4") ±5 mm	2 m (6.5') 3-wire	10-30V dc	NPN/ LO		
VS1AN5C10Q		3-Pin Pico-style Pigtail QD				
VS1RN5C10		2 m (6.5') 3-wire		NPN/ DO		
VS1RN5C10Q		3-Pin Pico-style Pigtail QD				
VS1AP5C10		2 m (6.5') 3-wire		NPN/ LO		
VS1AP5C10Q		3-Pin Pico-style Pigtail QD				
VS1RP5C10		2 m (6.5') 3-wire		NPN/ DO		
VS1RP5C10Q		3-Pin Pico-style Pigtail QD				
VS1AN5C20	20 mm (0.8") ±10 mm	2 m (6.5') 3-wire		NPN/ LO		
VS1AN5C20Q		3-Pin Pico-style Pigtail QD				
VS1RN5C20		2 m (6.5') 3-wire		NPN/ DO		
VS1RN5C20Q		3-Pin Pico-style Pigtail QD				
VS1AP5C20		2 m (6.5') 3-wire		NPN/ LO		
VS1AP5C20Q		3-Pin Pico-style Pigtail QD				
VS1RP5C20		2 m (6.5') 3-wire		NPN/ DO		
VS1RP5C20Q		3-Pin Pico-style Pigtail QD				

VS1 Series Dimensions

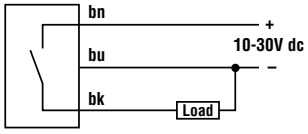


VS1 Series Hookup Diagrams

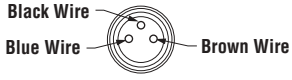
Sensors with NPN Outputs Cabled Hookup



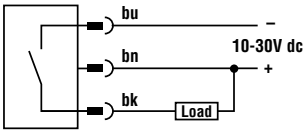
Sensors with PNP Outputs Cabled Hookup



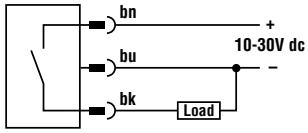
3-Pin Pico-Style Pin-out (Cable Connector Shown)



Quick-Disconnect Hookup



Quick-Disconnect Hookup



VS1 Series Specifications

Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 25 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	SPST solid-state switch Choose NPN (current sinking) or PNP (current sourcing) models Choose light operate (N.O.) or dark operate (N.C.) models
Output Rating	50 mA maximum **Off-state leakage current:** < 1 microamp at 24V dc **On-state saturation voltage:** < 0.25V at 10 mA dc; < 0.5V at 50 mA dc
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs Overload trip point ≥100 mA
Output Response Time	1 millisecond ON and OFF
Repeatability	250 microseconds
Indicators	Two LEDs: Green and Yellow GREEN **ON steadily** = power to sensor is ON GREEN **flashing** = output overload YELLOW **ON steadily** = light is sensed YELLOW **flashing** = marginal excess gain (1-1.5x) in light condition
Construction	Black ABS/polycarbonate housing with clear acrylic lens
Environmental Rating	IP67; NEMA 6
Connections	2 m (6.5') attached cable: three #28 ga stranded conductors with PE insulation; PVC outer cable jacket; or 3-pin Pico-style pigtail quick-disconnect fitting. QD cables are ordered separately.
Operating Conditions	**Temperature:** -20° to +55°C (-4° to +131°F) **Maximum Relative Humidity:** 80% at 50°C (non-condensing)
Application Notes	M2 stainless steel mounting hardware included (see "VS1 Mounting"). Optional mounting brackets are available. See page 63.
Certifications	CE

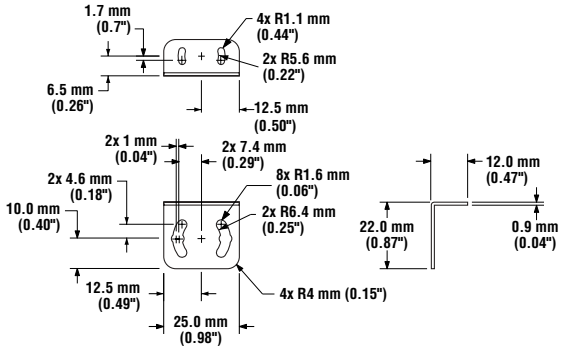
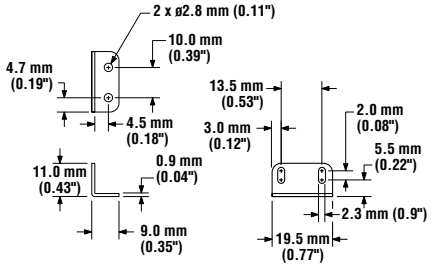
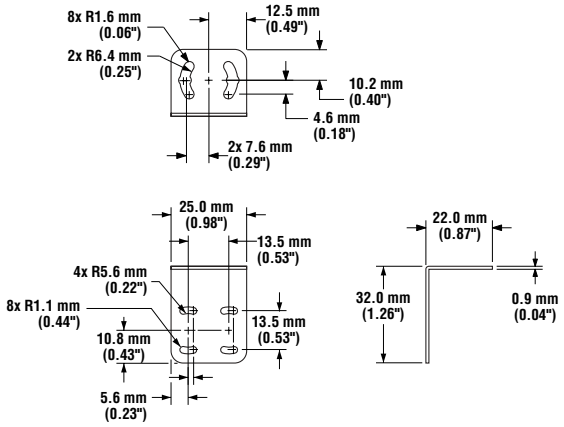
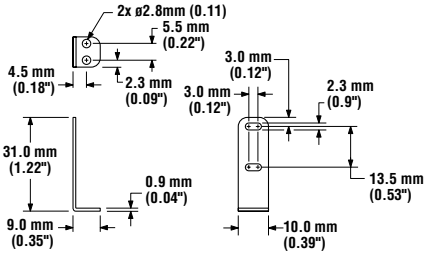
Accessories

Quick-Disconnect (QD) Cables

Following is the selection of cables available for VS1 QD models. See the Accessories section at back of catalog for more cable information.

Style	Model	Length	Connector	Used with:
3-Pin Pico	**PKG3M-2** **PKG3M-9**	2 m (6.5') 9 m (30')	Straight	VS1 with QD fitting

Mounting Brackets

Model	Description	Dimensions
SMBVS1S 	• Short bracket • Stainless steel	
SMBVS1SC 	• Short compact bracket • Stainless steel	
SMBVS1T 	• Tall bracket • Stainless steel	
SMBVS1TC 	• Tall compact bracket • Stainless steel	

VS2 Sensors

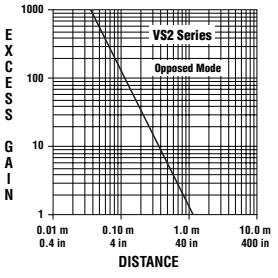
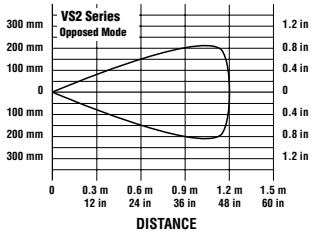
Miniature Self-Contained Sensors

- Totally self-contained miniature sensors
- 10 to 30V dc operation
- High-quality, low-cost replacement for competitive miniature sensors
- Visible red sensing beam
- Choose opposed or convergent-mode sensing
- Choose dark or light operate models
- Choose models with NPN (sinking) or PNP (sourcing) output
- 3-wire hookup; output load capacity to 50 mA
- Choice of integral cable or pigtail quick-disconnect connector

VS2 Sensing Mode Options

Visible red, 660 nm

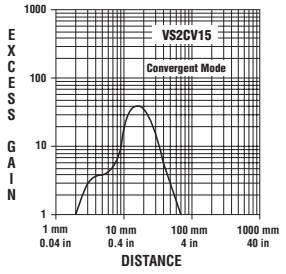
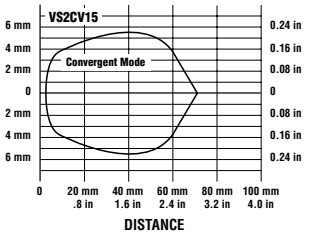
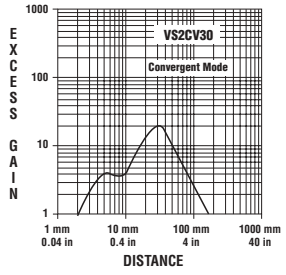
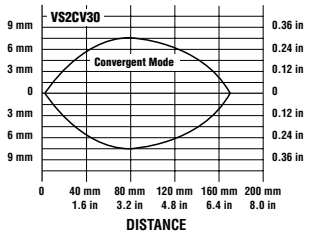
VS2 Series Opposed Mode Emitter (E) and Receiver (R)

Models*	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
VS2KAN5V Sensor Pair **VS25EV** Emitter **VS2AN5R** Receiver	Optimum up to 600 mm (24"), 1.2 m (48") max.	2 m (6.5') 2 wires 3 wires	10 to 30V dc	NPN/ Light Operate		Effective Beam: 3 mm 
VS2KAN5VQ Sensor Pair **VS25EVQ** Emitter **VS2AN5RQ** Receiver		3-Pin Pico-Style Pigtail QD		NPN/ Light Operate		
VS2KRN5V Sensor Pair **VS25EV** Emitter **VS2RN5R** Receiver		2 m (6.5') 2 wires 3 wires		NPN/ Dark Operate		
VS2KRN5VQ Sensor Pair **VS25EVQ** Emitter **VS2RN5RQ** Receiver		3-Pin Pico-Style Pigtail QD		NPN/ Dark Operate		
VS2KAP5V Sensor Pair **VS25EV** Emitter **VS2AP5R** Receiver		2 m (6.5') 2 wires 3 wires		PNP/ Light Operate		
VS2KAP5VQ Sensor Pair **VS25EVQ** Emitter **VS2AP5RQ** Receiver		3-Pin Pico-Style Pigtail QD		PNP/ Light Operate		
VS2KRP5V Sensor Pair **VS25EV** Emitter **VS2RP5R** Receiver		2 m (6.5') 2 wires 3 wires		PNP/ Dark Operate		
VS2KRP5VQ Sensor Pair **VS25EVQ** Emitter **VS2RP5RQ** Receiver		3-Pin Pico-Style Pigtail QD		PNP/ Dark Operate		

*NOTE: Sensors may be purchased in pairs, or individually.

Visible red, 660 nm

VS2 Series Convergent Mode Sensors

Models*	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
VS2AN5CV15 **VS2AN5CV15Q**	15 mm (0.6") ±5 mm	2 m (6.5') 3-Pin Pico QD	10 to 30V dc	NPN Light Operate		
VS2RN5CV15 **VS2RN5CV15Q**		2 m (6.5') 3-Pin Pico QD		NPN Dark Operate		
VS2AP5CV15 **VS2AP5CV15Q**		2 m (6.5') 3-Pin Pico QD		PNP Light Operate		
VS2RP5CV15 **VS2RP5CV15Q**		2 m (6.5') 3-Pin Pico QD		PNP Dark Operate		
VS2AN5CV30 **VS2AN5CV30Q**	30 mm (1.2") ±10 mm	2 m (6.5') 3-Pin Pico QD		NPN Light Operate		
VS2RN5CV30 **VS2RN5CV30Q**		2 m (6.5') 3-Pin Pico QD		NPN Dark Operate		
VS2AP5CV30 **VS2AP5CV30Q**		2 m (6.5') 3-Pin Pico QD		PNP Light Operate		
VS2RP5CV30 **VS2RP5CV30Q**		2 m (6.5') 3-Pin Pico QD		PNP Dark Operate		

For VS2 Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **VS2AN5CV15 W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 68 and the Accessories section for more information.

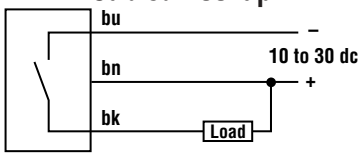
*Performance based on 90% reflectance white test card

VS2 Series Specifications

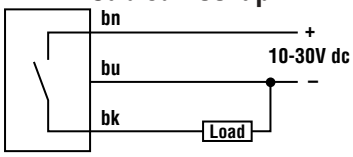
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 25 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	SPST solid-state switch Choose NPN (current sinking) or PNP (current sourcing) models Choose light operate (N.O.) or dark operate (N.C.) models
Output Rating	50 mA maximum **Off-state leakage current:** < 1 microamp at 24V dc **On-state saturation voltage:** < 0.25V at 10 mA dc; < 0.5V at 50 mA dc
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs Opposed Mode: Overload trip point ≥ 100 mA Convergent: Overload trip point ≥ 160 mA
Output Response Time	**Opposed:** 1 millisecond ON and 0.5 millisecond OFF; **Convergent:** 1 millisecond ON and OFF (NOTE: 100 millisecond (opposed mode) and 150 millisecond (convergent) delay maximum on power-up: output does not conduct during this time)
Repeatability	Opposed Mode: 100 microseconds Convergent: 160 microseconds
Indicators	Two LEDs: Green and Yellow GREEN **ON steadily** = power to sensor is ON GREEN **flashing** = output overload YELLOW **ON steadily** = light is sensed YELLOW **flashing** = marginal excess gain (1-1.5x) in light condition (opposed mode only)
Construction	**Opposed :** Black ABS housing with clear MABS lens **Convergent:** Black ABS housing with acrylic lens
Environmental Rating	IEC IP67; NEMA 6
Connections	2 m (6.5') attached cable: #28 ga stranded conductors with PE insulation; PVC outer cable jacket; or 3-pin Pico-style pigtail quick-disconnect fitting. QD cables are ordered separately.
Operating Conditions	**Temperature:** -20° to +55°C (-4° to +131°F) **Maximum Relative Humidity:** 80% at 50°C (non-condensing)
Vibration and Mechanical Shock	**Vibration:** All models meet IEC 60068-2-6, IEC 60947-5-2, UL491 Section 40, MIL-STD-202F Method 201A; 10 to 60 Hz, 0.5 mm peak to peak **Shock:** All models meet IEC 60068-2-27, IEC 60947-5-2; 30g peak acceleration, 11 millisecond pulse duration, half-sine wave pulse shape
Application Notes	M2 stainless steel mounting hardware included. Optional mounting brackets are available (page 68).
Certifications	CE

VS2 Series Hookup Diagrams

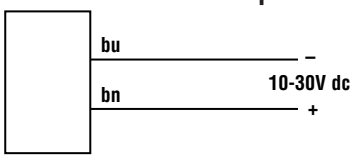
Sensors with NPN Outputs Cabled hookup



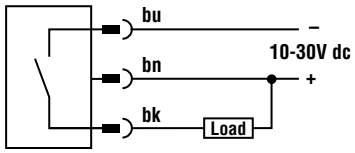
Sensors with PNP Outputs Cabled hookup



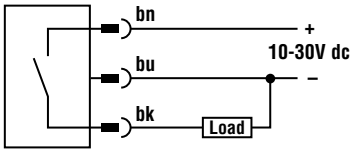
Emitters Cabled hookup



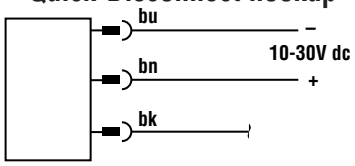
Quick-Disconnect hookup



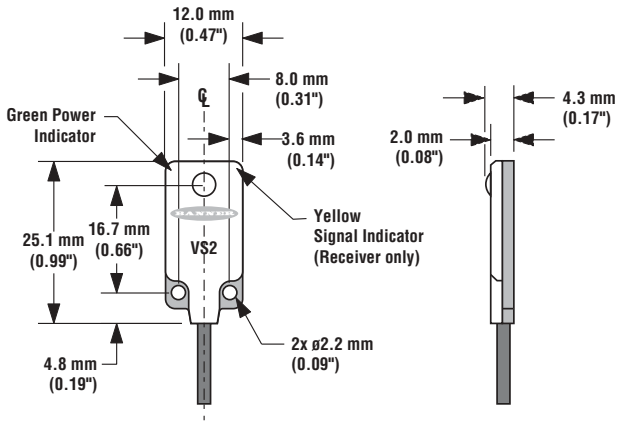
Quick-Disconnect hookup

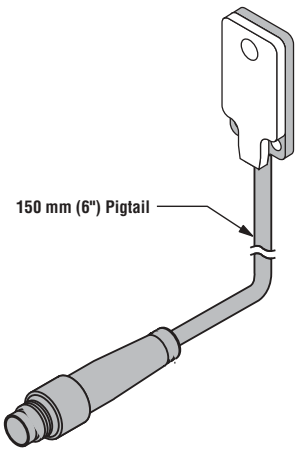


Quick-Disconnect hookup

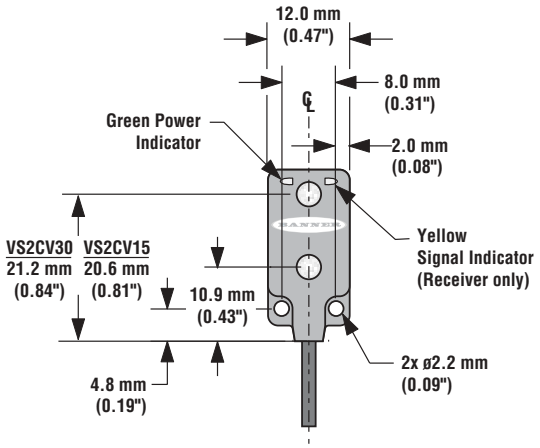


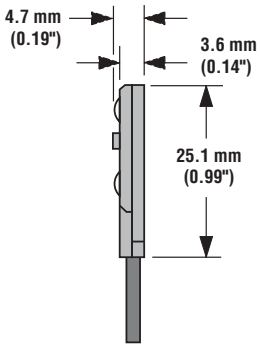
VS2 Series Opposed Mode Sensor Dimensions





VS2 Series Convergent Mode Sensor Dimensions



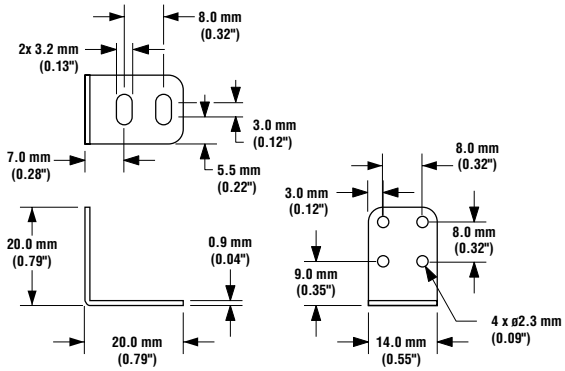


Quick-Disconnect (QD) Cables

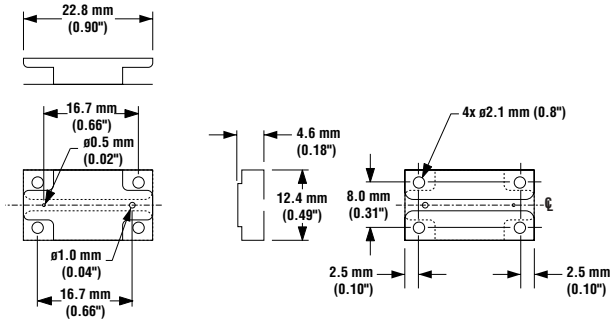
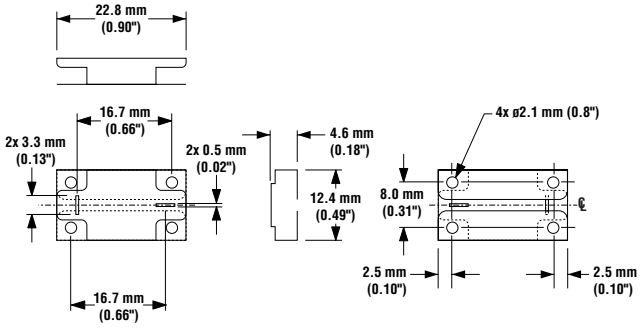
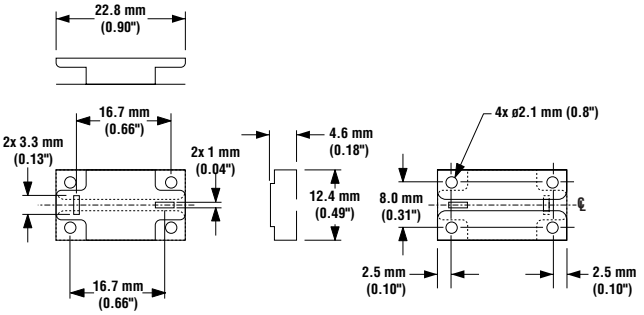
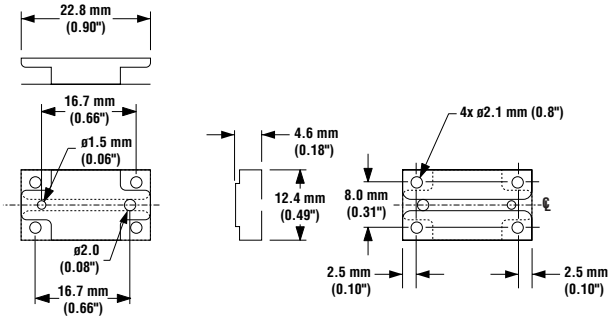
Following is the selection of cables available for VS2 QD models. See the Accessories section at back of catalog for more cable information.

Style	Model	Length	Connector	Used with:
3-Pin Pico	**PKG3M-2** **PKG3M-9**	2 m (6.5') 9 m (30')	Straight	VS2 with QD fitting

Mounting Brackets

Model	Description	Dimensions
SMBVS2RA 	• Right-angle bracket • Stainless steel	

Apertures for Use on Opposed Mode Models

Model	Description	Dimensions
APVS2-0204	• 0.5 mm and 1.0 mm apertures • 0.1 mm stainless steel • Includes two apertures	
APVS2-02R	• 0.5 mm wide aperture - horizontal and vertical • 0.1 mm stainless steel • Includes two apertures	
APVS2-04R	• 1 mm wide aperture - horizontal and vertical • 0.1 mm stainless steel • Includes two apertures	
APVS2-0608	• 1.5 mm and 2.0 mm apertures • 0.1 mm stainless steel • Includes two apertures	

VS3 Sensors

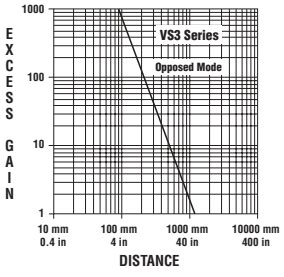
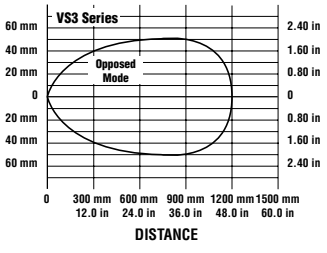
Miniature Self-Contained Sensors

- Extremely compact self-contained miniature sensor
- 10 to 30V dc operation
- Visible red sensing beam
- Choose opposed or retroreflective mode models
- Choose dark- or light-operate models
- Choose models with NPN (sinking) or PNP (sourcing) output
- 3-wire hookup; output load capacity to 50 mA
- Choice of integral cable or quick-disconnect connector

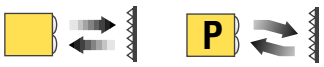
VS3 Sensing Mode Options

Visible red, 660 nm

VS3 Series Opposed Mode Emitter (E) and Receiver (R)

Models*	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
VS3KAN5V Sensor Pair **VS35EV** Emitter **VS3AN5R** Receiver	1.2 m (3.96')	2 m (6.5') 2 wires 3 wires	10 to 30V dc	NPN/ Light Operate		Effective Beam: 3 mm 
VS3KAN5VQ Sensor Pair **VS35EVQ** Emitter **VS3AN5RQ** Receiver		3-Pin Pico QD		NPN/ Light Operate		
VS3KRN5V Sensor Pair **VS35EV** Emitter **VS3RN5R** Receiver		2 m (6.5') 2 wires 3 wires		NPN/ Dark Operate		
VS3KRN5VQ Sensor Pair **VS35EVQ** Emitter **VS3RN5RQ** Receiver		3-Pin Pico QD		NPN/ Dark Operate		
VS3KAP5V Sensor Pair **VS35EV** Emitter **VS3AP5R** Receiver		2 m (6.5') 2 wires 3 wires		PNP/ Light Operate		
VS3KAP5VQ Sensor Pair **VS35EVQ** Emitter **VS3AP5RQ** Receiver		3-Pin Pico QD		PNP/ Light Operate		
VS3KRP5V Sensor Pair **VS35EV** Emitter **VS3RP5R** Receiver		2 m (6.5') 2 wires 3 wires		PNP/ Dark Operate		
VS3KRP5VQ Sensor Pair **VS35EVQ** Emitter **VS3RP5RQ** Receiver		3-Pin Pico QD		PNP/ Dark Operate		

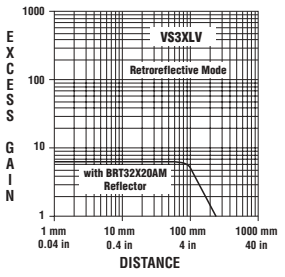
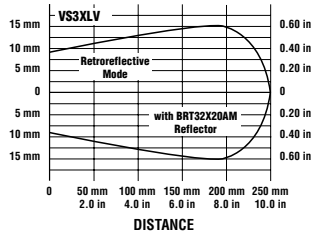
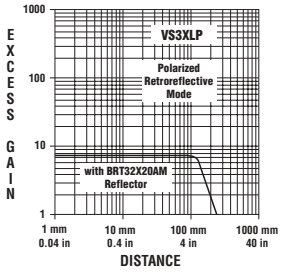
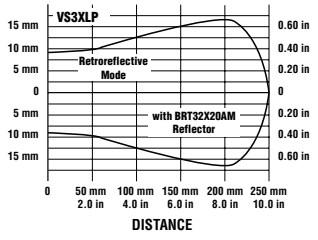
*NOTE: Sensors may be purchased in pairs, or individually.



Visible red, 680 nm

Coaxial optics eliminate “blind” area at close range.

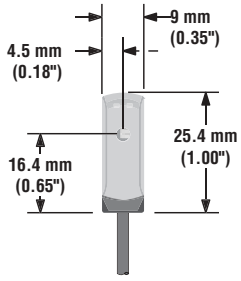
VS3 Series Retroreflective Mode Sensors

Models		Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
VS3AN5XLV **VS3AN5XLVQ**	250 mm (10") using BRT32X20AM retro target (supplied)	2 m (6.5') 3-Pin Pico QD	10 to 30V dc	NPN Light Operate		
VS3RN5XLV **VS3RN5XLVQ**		2 m (6.5') 3-Pin Pico QD		NPN Dark Operate		
VS3AP5XLV **VS3AP5XLVQ**		2 m (6.5') 3-Pin Pico QD		PNP Light Operate		
VS3RP5XLV **VS3RP5XLVQ**		2 m (6.5') 3-Pin Pico QD		PNP Dark Operate		
Polarized						
VS3AN5XLP **VS3AN5XLPQ**	250 mm (10") using BRT32X20AM retro target (supplied)	2 m (6.5') 3-Pin Pico QD	10 to 30V dc	NPN Light Operate		
VS3RN5XLP **VS3RN5XLPQ**		2 m (6.5') 3-Pin Pico QD		NPN Dark Operate		
VS3AP5XLP **VS3AP5XLPQ**		2 m (6.5') 3-Pin Pico QD		PNP Light Operate		
VS3RP5XLP **VS3RP5XLPQ**		2 m (6.5') 3-Pin Pico QD		PNP Dark Operate		

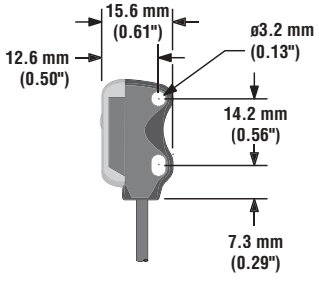
VS3 Series Sensor Dimensions

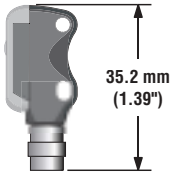
Opposed and Non-Polarized Retroreflective Modes (model suffix R, EV and XLV)

Cabled Models

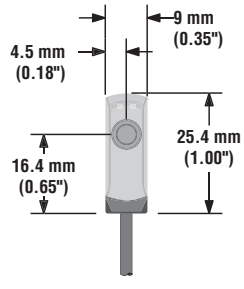


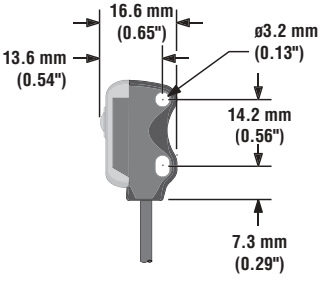
Quick-Disconnect Models

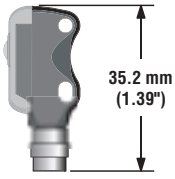




Polarized Retroreflective Modes (model suffix XLP)

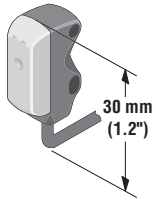




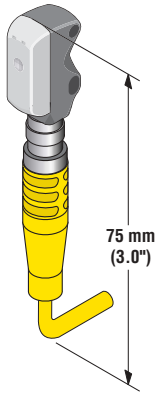


Cable Options

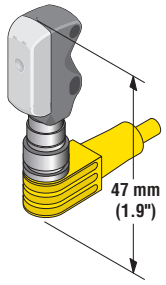
With Integral Cable



With Straight QD Cable



With Right-angle QD Cable

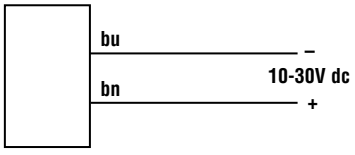


VS3 Series Specifications

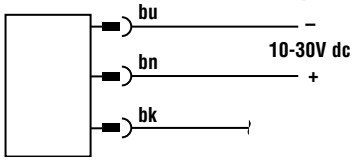
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 25 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	SPST solid-state switch Choose NPN (current sinking) or PNP (current sourcing) models Choose light operate (N.O.) or dark operate (N.C.) models
Output Rating	50 mA maximum **Off-state leakage current:** < 1 microamp at 24V dc **On-state saturation voltage:** < 0.25V at 10 mA dc; < 0.5V at 50 mA dc
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs Overload trip point ≥ 100 mA
Output Response Time	**Opposed:** 1 millisecond ON and 0.5 millisecond OFF; **Retroreflective:** 1 millisecond ON and OFF (NOTE: 100 microseconds (opposed mode) and 150 millisecond (convergent) delay maximum on power-up: output does not conduct during this time)
Repeatability	**Opposed Mode:** 100 microseconds **Retroreflective:** 160 microseconds
Indicators	Two LEDs: Green and Yellow GREEN **ON steady** = power to sensor is ON GREEN **flashing** = output overload YELLOW **ON steady** = light is sensed YELLOW **flashing** = marginal excess gain (1-1.5x) in light condition (opposed mode only)
Construction	**Opposed and Non-polarized Retroreflective Models:** Black ABS housing with acrylic lens **Polarized Retroreflective Models:** Black ABS housing with glass lens and acrylic cover
Environmental Rating	IEC IP67; NEMA 6
Connections	2 m (6.5') attached cable: #28 ga stranded conductors with PE insulation; PVC outer cable jacket; or 3-pin Pico-style threaded quick-disconnect fitting. QD cables are ordered separately.
Operating Conditions	**Temperature:** -20° to +55°C (-4° to +131°F) **Maximum Relative Humidity:** 80% at 50°C (non-condensing)
Vibration and Mechanical Shock	**Vibration:** All models meet IEC 60068-2-6, IEC 60947-5-2, UL491 Section 40, MIL-STD-202F Method 201A; 10 to 60 Hz, 0.5 mm peak to peak **Shock:** All models meet IEC 60068-2-27, IEC 60947-5-2; 30g peak acceleration, 11 millisecond pulse duration, half-sine wave pulse shape
Application Notes	M3 stainless steel mounting hardware included. Optional mounting brackets are available (page 73).
Certifications	CE

VS3 Series Sensor Hookups

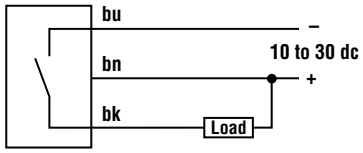
Emitters
Cabled hookup



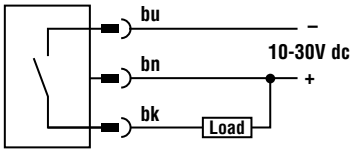
Quick-Disconnect hookup



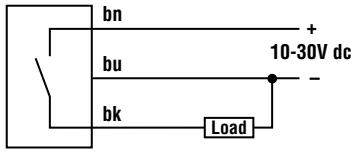
Sensors with NPN Outputs
Cabled hookup



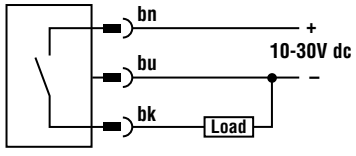
Quick-Disconnect hookup



Sensors with PNP Outputs
Cabled hookup



Quick-Disconnect hookup

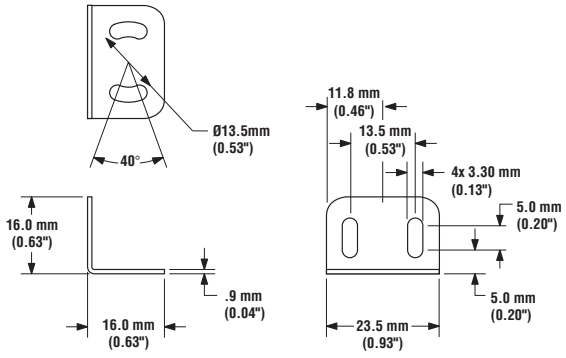
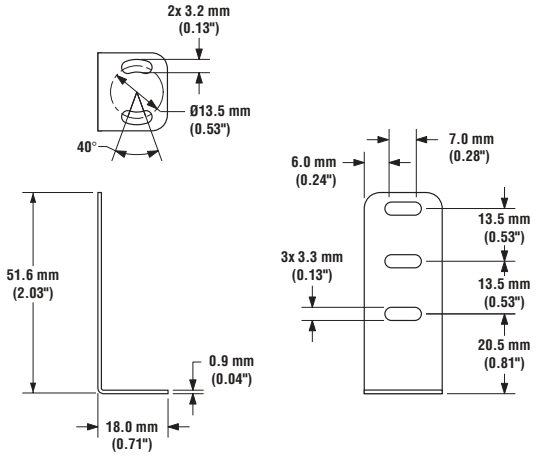


Quick-Disconnect (QD) Cables

Following is the selection of cables available for VS3 QD models. See the Accessories section at back of catalog for more cable information.

Style	Model	Length	Connector	Used with:
3-Pin Pico	**PKG3M-2** **PKG3M-9** **PKW3M-2** **PKW3M-9**	2 m (6.5') 9 m (30') 2 m (6.5') 9 m (30')	Straight Straight Right-angle Right-angle	VS3 with QD fitting

Mounting Brackets

Model	Description	Dimensions
SMBVS3S 	• Right-angle bracket • 300 series stainless steel	
SMBVS3T 	• Right-angle tall bracket • 300 series stainless steel	

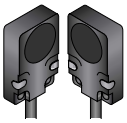
Q08 Sensors

Low-Profile Infrared Sensors with Metal Housings

Q08 Diffuse Mode shown

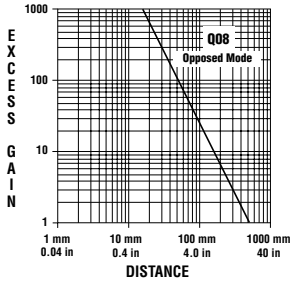
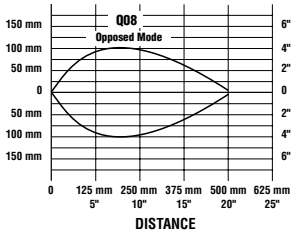
- Miniature right-angle dc photoelectric sensors in rugged die-cast metal housings
- Totally self-contained; 10 to 30V dc operation
- Circuitry is completely sealed and epoxy-encapsulated; rated IP67 and NEMA 6
- Choose opposed or diffuse mode models
- Choose models with NPN (sinking) or PNP (sourcing) output
- Choose light operate or dark operate models
- 3-wire hookup; output load capacity to 150 milliamps
- LED indicators for Power ON and Output ON; Output indicator may be used for alignment
- 2 m (6.5') is standard integral cable length; 9 m (30') cable is also available
- Diffuse mode models with quick-disconnect have Pico-style connector; mating cables are ordered separately

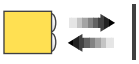
Q08 Sensing Mode Options



Infrared, 880 nm

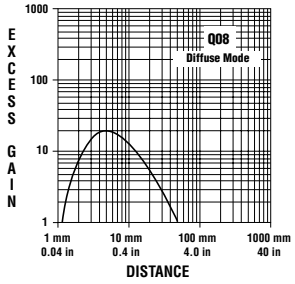
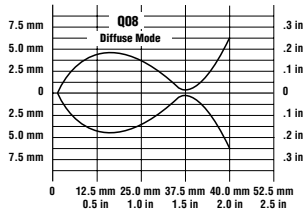
Q08 Opposed Mode Emitter (S) and Receiver (E)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SO60-Q08	510 mm (20")	2 m (6.5')	10-30V dc	–		Effective Beam: 6.4 mm 
EO60-Q08-AN6X				NPN/LO		
EO60-Q08-RN6X				NPN/DO		
EO60-Q08-AP6X				PNP/LO		
EO60-Q08-RP6X				PNP/DO		



Infrared, 880 nm

Q08 Diffuse Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
NO5-Q08-AN7 **NO5-Q08-AN7-V1131**	2.5 mm to 60 mm (0.1" to 2.4")	2 m (6.5') 3-Pin Pico QD	10-30V dc	NPN/LO		
NO5-Q08-RN7 **NO5-Q08-RN7-V1131**		2 m (6.5') 3-Pin Pico QD		NPN/DO		
NO5-Q08-AP7 **NO5-Q08-AP7-V1131**		2 m (6.5') 3-Pin Pico QD		PNP/LO		
NO5-Q08-RP7 **NO5-Q08-RP7-V1131**		2 m (6.5') 3-Pin Pico QD		PNP/DO		

For Q08 Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SO60-Q08 W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 79 and the Accessories section for more information.

Q08 Specifications

Supply Voltage and Current	**Opposed:** 10 to 30V dc at 50 mA total maximum; 30 mA for emitter, 20 mA for receiver (exclusive of load); **Diffuse:** 10 to 30V dc at 25 mA Both modes at 10% maximum ripple
Supply Protection Circuitry	Protected against reverse polarity and continuous overload or short circuit
Output Configuration	**Solid-state dc output, with four output types available:** NPN sinking/light operate — PNP sourcing/light operate NPN sinking/dark operate — PNP sourcing/dark operate **Opposed:** Light operate outputs conduct when the receiver sees the emitter's pulse-synchronized light source; Dark operate outputs conduct when the receiver does not see the emitter's pulse-synchronized source **Diffuse:** Light operate outputs conduct when the sensor sees the reflection of its own modulated light source; Dark operate outputs conduct when the sensor sees dark
Output Rating	150mA maximum, continuous **Off-state leakage** current is 100 microamps at 30V dc **On-state saturation** voltage is <200 millivolts at 10 mA dc and <1 volt at 150 mA dc
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	1 millisecond ON and OFF independent of signal strength
Repeatability	200 microseconds (0.2 milliseconds), independent of signal strength
Indicators	**Two LED indicators:** GREEN LED lights to indicate dc power "ON" YELLOW LED (except opposed emitters) lights when sensor output is conducting (in "light" condition for light operate models; in "dark" condition for dark operate models)
Construction	Black epoxy-painted die-cast zinc housing, polysulfone thermoplastic lens with two through-mounting holes to accommodate M3 (#4) hardware
Environmental Rating	Meets NEMA standards 1, 2, 4, 6, 12 and 13; IEC IP67
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cable or 3-pin pico-style quick-disconnect (QD) fitting (diffuse models) available. See page 79 and Accessories section. Cable is 4.0 mm (0.16") in diameter.
Operating Conditions	**Temperature:** 0° to 50° C (32° to +122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Be aware that optimum mechanical alignment of Q08 emitter/receiver pairs may not always result in optimum optical alignment. This may be a factor at longer sensing ranges. Once optimum mechanical alignment has been achieved, optical alignment can often be optimized by tilting one unit (emitter or receiver) up/down and right/left. Look for the center of the "movement zone" within which the receiver's output remains in the desired output state: "ON" for light operate units, and "OFF" for dark operate units.
Certifications	CE

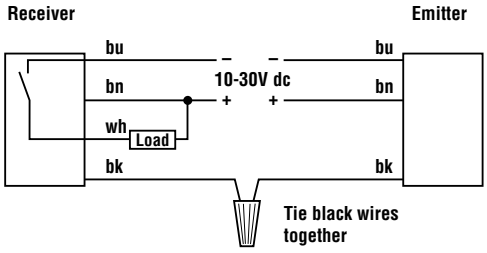
Quick-Disconnect (QD) Option

Q08 sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable. Q08 Diffuse mode sensors are also available with a 3-pin pico-style QD cable fitting.

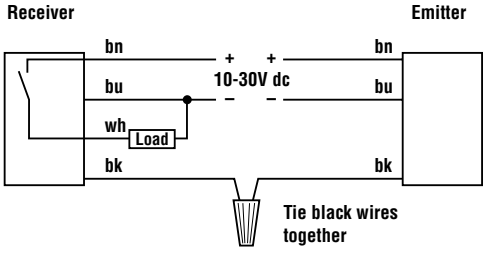
Q08 QD Diffuse sensors are identified by the letters "V1131" in their model number suffix. Mating cables for Q08 QD Diffuse sensors are model PKG3-2 and PKW3-2. Cables are supplied in a standard length of 2 m (6.5'). For more information on QD cables, see page 79 and the Accessories section.

Q08 Hookup Diagrams

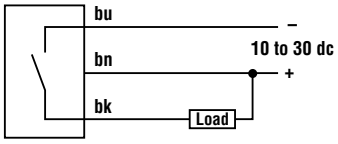
Opposed Mode NPN (Sinking) Receiver



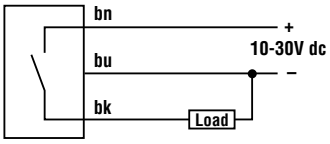
Opposed Mode PNP (Sourcing) Receiver



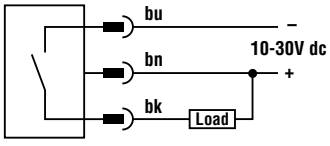
Diffuse Mode Cabled Models NPN (Sinking)



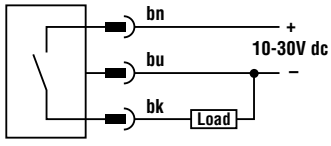
Diffuse Mode Cabled Models PNP (Sourcing)



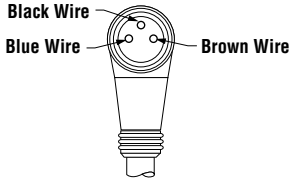
Diffuse Mode QD Models NPN (Sinking) (3-Pin Pico-Style)



Diffuse Mode QD Models PNP (Sourcing) (3-Pin Pico-Style)

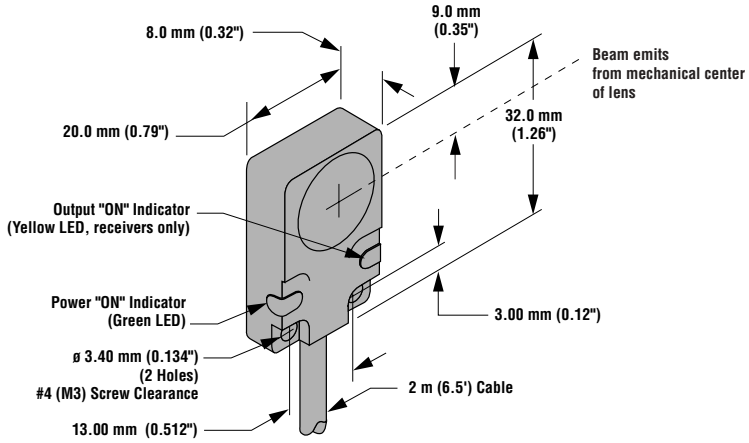


3-Pin Pico-Style Pin-out

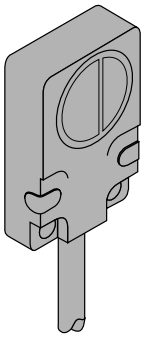


Q08 Dimensions

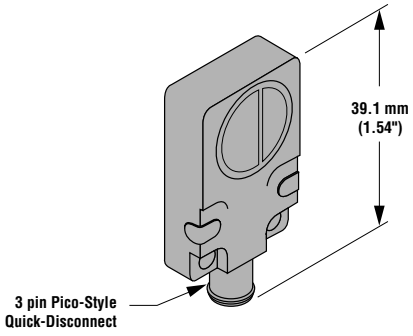
Q08 Opposed Mode Sensor with Attached Cable



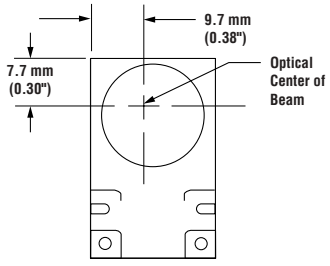
Q08 Diffuse Mode Sensor with Attached Cable



Q08 Diffuse Mode Sensor with Quick-Disconnect



Q08 Diffuse Mode Sensor Optical Center



Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All Q08 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	S060-Q08 W/30

Quick-Disconnect (QD) Cables

Following is the selection of cables available for Q10 QD models. See the Accessories section at back of catalog for more cable information.

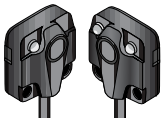
Style	Model	Length	Connector	Used with:
3-Pin Pico	**PKG3-2** **PKW3-2**	2 m (6.5') 2 m (6.5')	Straight Right-angle	Q08 with QD fitting

Q10 Sensors

Miniature Self-Contained dc Photoelectric Sensors

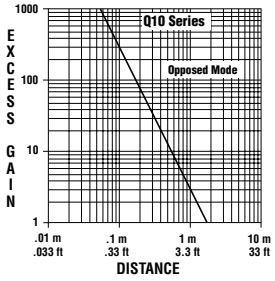
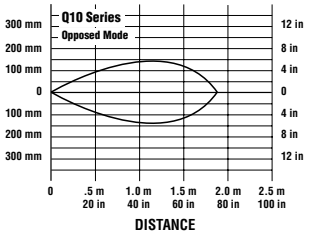
- Self-contained dc sensors in miniature right-angle housings; only 10 mm (0.4") thick
- 10 to 30V dc operation
- Epoxy-encapsulated circuitry; leakproof IP67 (NEMA 6P) construction; hermetically-sealed optics
- 1.8 m (70") opposed range or 0.5 m (20") diffuse range; diffuse models have sensitivity adjustment
- Choose models for light operate or dark operate; choose either NPN (sinking) or PNP (sourcing) output models
- Choice of integral cable or quick-disconnect connector

Q10 Sensing Mode Options



Infrared, 880 nm

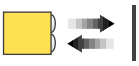
Q10 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	NPN/ PNP	L.O./ D.O.	Excess Gain	Beam Pattern
Q106E **Q106EQ**	1.8 m (70")	2 m (6.5') 3-Pin Pico QD	10-30V dc	–	–		Effective Beam: 5 mm 
Q10AN6R **Q10AN6RQ**		2 m (6.5') 3-Pin Pico QD		NPN	L.O.		
Q10RN6R **Q10RN6RQ**		2 m (6.5') 3-Pin Pico QD			D.O.		
Q10AP6R **Q10AP6RQ**		2 m (6.5') 3-Pin Pico QD		PNP	L.O.		
Q10RP6R **Q10RP6RQ**		2 m (6.5') 3-Pin Pico QD			D.O.		

For Q10 Sensors:

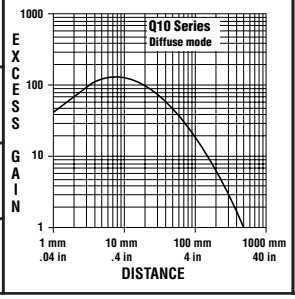
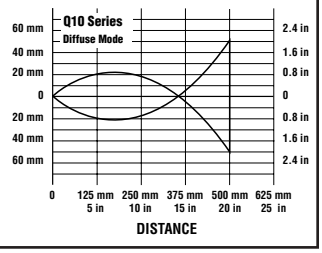
i) 9 m (30') cables are available by adding suffix "w/30" to the model number of any cabled sensor (e.g. **Q10AN6R W/30**).

ii) A model with a QD connector requires an accessory mating cable. See page 83 and the Accessories section for more information.



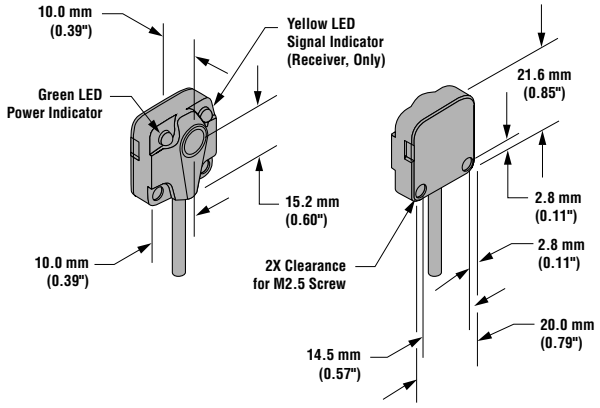
Infrared, 880 nm

Q10 Diffuse Mode

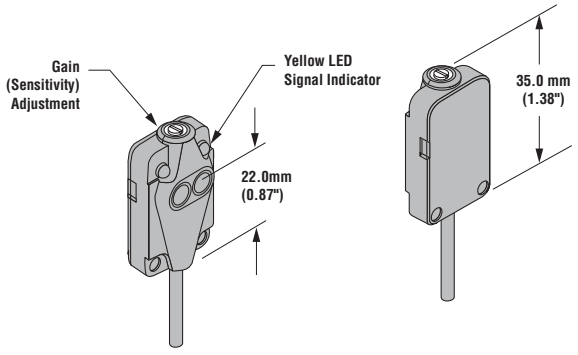
Models	Range	Cable	Supply Voltage	NPN/ PNP	L.O./ D.O.	Excess Gain	Beam Pattern
						Performance based on 90% reflectance white test card	
Q10AN6D **Q10AN6DQ**	0.5 m (20")	2 m (6.5') 3-Pin Pico QD	10-30V dc	NPN	L.O.		
Q10RN6D **Q10RN6DQ**		2 m (6.5') 3-Pin Pico QD			D.O.		
Q10AP6D **Q10AP6DQ**		2 m (6.5') 3-Pin Pico QD		PNP	L.O.		
Q10RP6D **Q10RP6DQ**		2 m (6.5') 3-Pin Pico QD			D.O.		

Q10 Dimensions

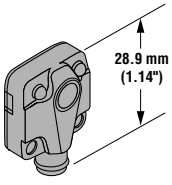
Q10 Opposed Mode with Attached Cable



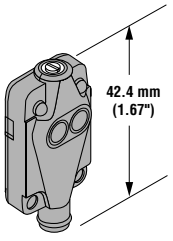
Q10 Diffuse Mode with Attached Cable



Q10 Opposed Mode with Quick-Disconnect



Q10 Diffuse Mode with Quick-Disconnect



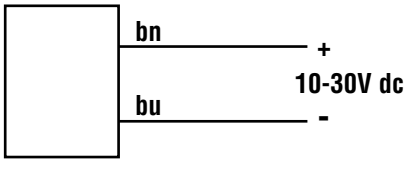
NOTE: M2.5 mounting hardware is supplied with all models

Q10 Specifications

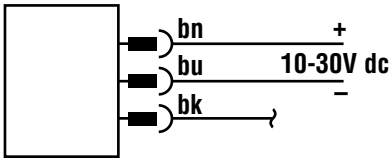
Supply Voltage and Current	10 to 30V dc (10% maximum ripple); Emitter or receiver: 15 mA; Diffuse models: 20 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity
Output Configuration	SPST solid-state dc switch; Choose NPN (current sinking) or PNP (current sourcing) models Choose light operate (N.O.) or dark operate (N.C.) models
Output Rating	150 mA maximum **Off-state leakage current:** <10 microamps at 30V dc; **On-state saturation voltage:** <0.5V at 10 mA dc; <1.0V at 150 mA dc
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs Overload trip point ≥220 mA, typical, at 20ºC
Output Response Time	Opposed mode: 8 ms "ON", 4 ms “OFF”; Diffuse mode: 3 ms “ON” and “OFF”
Repeatability	**Opposed mode:** 1.0 ms; **Diffuse mode**: 0.75 ms
Adjustments	Diffuse models (only); single-turn, top-mounted SENSITIVITY control for adjustment of system gain (turn clockwise to increase)
Indicators	**Two LEDs:** Green and Yellow GREEN **glowing steadily** = power to sensor is “ON” GREEN **flashing** = output is overloaded YELLOW **glowing steadily** = light is sensed YELLOW **flashing** = marginal excess gain (1-1.5x) in light condition Emitter: One GREED LED indicates power to sensor is “ON”
Construction	Housings are black ABS; Rated UL 94V0 Lenses are hermetically-sealed glass Circuitry is epoxy-encapsulated and completely sealed Stainless steel M2.5 mounting hardware is included
Environmental Rating	IP67 (NEMA 6P)
Connections	2 m (6.5') or 9 m (30') attached cable, or 3-pin pico-style quick-disconnect fitting. QD cables are ordered separately. See page 83 and Accessories section.
Operating Conditions	**Temperature:** -40° to +70°C (-40° to 158°F) **Maximum Relative Humidity:** 90% at 50°C (non-condensing)
Certifications	CE

Q10 Hookup Diagrams

Cabled Emitters



Quick-Disconnect Emitters



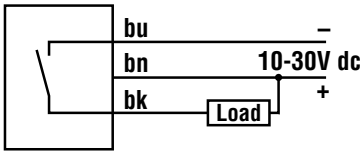
Quick-Disconnect (QD) Option

Q10 sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable or with a 3-pin pico-style QD cable fitting.

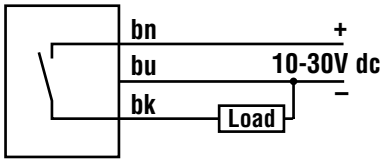
Q10 QD sensors are identified by the letter “Q” in their model number suffix. Mating cables for QD Q10 sensors are models PKG3-2 (straight connector) and PKW3-2 (right-angle connector). Cables are supplied in a standard length of 2 m (6.5'). For more information on QD cables, see page 83 and the Accessories section.

Q10 DC Hookup Diagrams

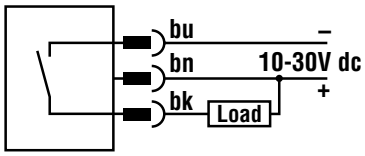
Sensors with NPN Outputs Cabled Hookup



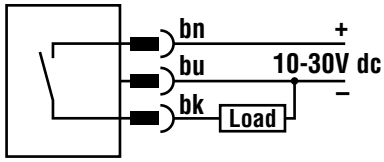
Sensors with PNP Outputs Cabled Hookup



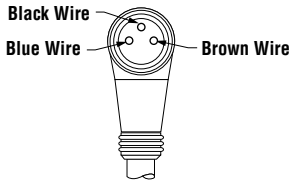
Quick-Disconnect Hookup



Quick-Disconnect Hookup



3-Pin Pico-Style Pin-out (Cable Connector Shown)



Accessories

Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	Q10 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	Q10AN6R W/30

Quick-Disconnect (QD) Cables

Following is the selection of cables available for Q10 QD models. See the Accessories section at back of catalog for more cable information.

Style	Model	Length	Connector	Used with:
3-Pin Pico	**PKG3-2** **PKW3-2**	2 m (6.5') 2 m (6.5')	Straight Right-angle	Q10 with QD fitting

Q14 Sensors

Miniature Right-Angle Self-Contained dc Sensors

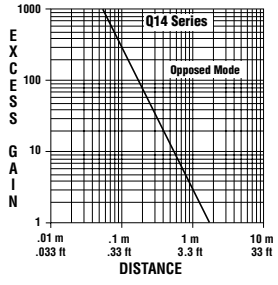
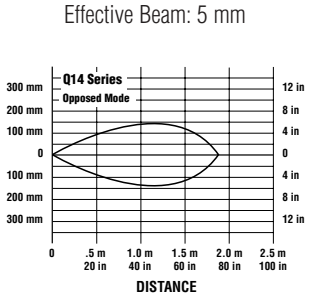
- Self-contained dc sensors in miniature right-angle housings
- 10 to 30V dc operation
- IP54; NEMA 4 construction; hermetically-sealed optics
- 1.8 m (70") opposed range
- Choose models for light operate or dark operate; choose either NPN (sinking) or PNP (sourcing) output models
- Choice of integral cable or pigtail quick-disconnect connector
- Mounting bracket is included

Q14 Sensing Mode Options

Opposed

Infrared, 880 nm

Q14 Opposed Mode Emitter (E) and Receiver (R)

Model	Range	Cable	Supply Voltage	NPN/ PNP	L.O./ D.O.	Excess Gain	Beam Pattern
Q146E **Q146EQ**	1.8 m (70")	2 m (6.5') 3-Pin Pigtail Pico QD	10-30V dc	—	—		
Q14AN6R **Q14AN6RQ**		2 m (6.5') 3-Pin Pigtail Pico QD		NPN	L.O.		
Q14RN6R **Q14RN6RQ**		2 m (6.5') 3-Pin Pigtail Pico QD			D.O.		
Q14AP6R **Q14AP6RQ**		2 m (6.5') 3-Pin Pigtail Pico QD		PNP	L.O.		
Q14RP6R **Q14RP6RQ**		2 m (6.5') 3-Pin Pigtail Pico QD			D.O.		

For Q14 Sensors:

i) 9 m (30') cables are available by adding suffix "w/30" to the model number of any cabled sensor (e.g. **Q14AN6R W/30**).

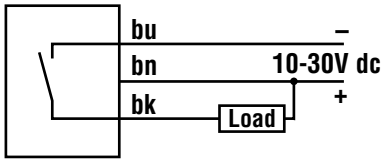
ii) A model with a QD connector requires an accessory mating cable. See page 88 and the Accessories section for more information.

Q14 Specifications

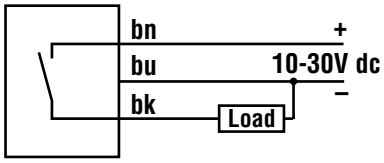
Supply Voltage and Current	10 to 30V dc (10% maximum ripple); Emitter: 15 mA; Receiver: 15 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity
Output Configuration	SPST solid-state dc switch; Choose NPN (current sinking) or PNP (current sourcing) models Choose light operate (N.O.) or dark operate (N.C.) models
Output Rating	150 mA maximum **Off-state leakage current:** <10 microamps at 30V dc; **On-state saturation voltage:** <0.5V at 10 mA dc; <1.0V at 150 mA dc
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs Overload trip point ≥220 mA, typical, at 20ºC
Output Response Time	8 ms “ON”, 4 ms “OFF”
Repeatability	1.0 ms
Indicators	Receiver has two LEDs: Green and Yellow GREEN **glowing steadily** = power to sensor is “ON” GREEN **flashing** = output is overloaded YELLOW **glowing steadily** = light is sensed YELLOW **flashing** = marginal excess gain (1-1.5x) in light condition Emitter: One GREEN LED indicates power to sensor is “on”
Construction	Housings are black ABS; Rated UL 94V0 Lenses are hermetically-sealed glass Stainless steel M3 mounting hardware is included; Stainless steel mounting bracket is included
Environmental Rating	IP54; NEMA 4
Connections	2 m (6.5') or 9 m (30') attached cable, or 3-pin pigtail pico-style quick-disconnect fitting. QD cables are ordered separately. See page 88 and the Accessories section.
Operating Conditions	**Temperature:** -20° to +55°C (-5° to 131°F) **Maximum Relative Humidity**: 90% at 50ºC (non-condensing)
Certifications	CE

Q14 Hookup Diagrams

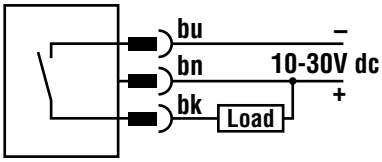
Sensors with NPN Outputs Cabled Hookup



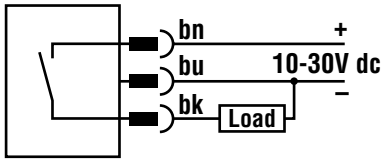
Sensors with PNP Outputs Cabled Hookup



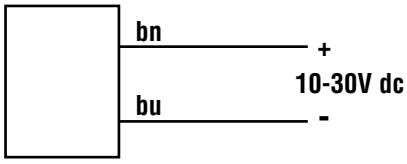
Quick-Disconnect Hookup



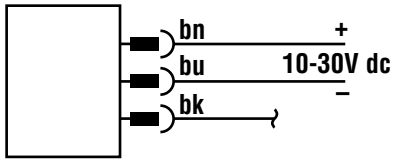
Quick-Disconnect Hookup



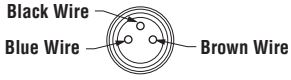
Cabled Emitters



Quick-Disconnect Emitters



3-Pin Pico-Style Pin-out (Cable Connector Shown)



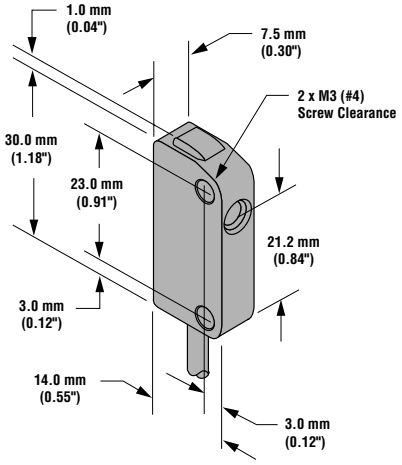
Quick-Disconnect (QD) Option

Q14 sensors are sold with either a 2 m (6.5') or 9 m (30') attached PVC-covered cable or a 3-pin pico-style QD cable fitting.

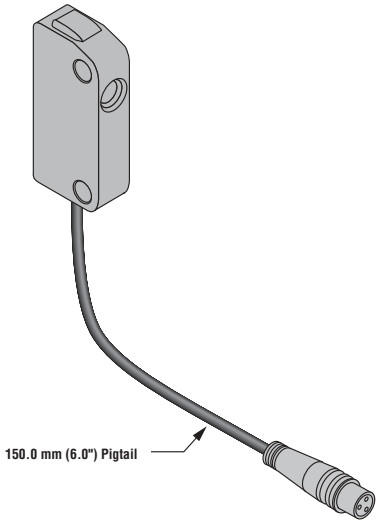
Q14 QD sensors are identified by the letter “Q” in their model number suffix. Mating cables for QD Q14 sensors are models PKG3-2 (straight connector) and PKW3-2 (right-angle connector). Cables are supplied in a standard length of 2 m (6.5'). For more information on QD cables, see page 88 and the Accessories section.

Q14 Dimensions

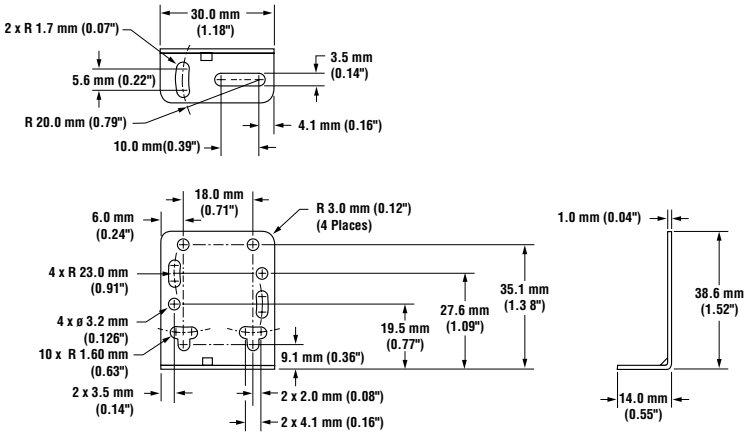
Cabled Models



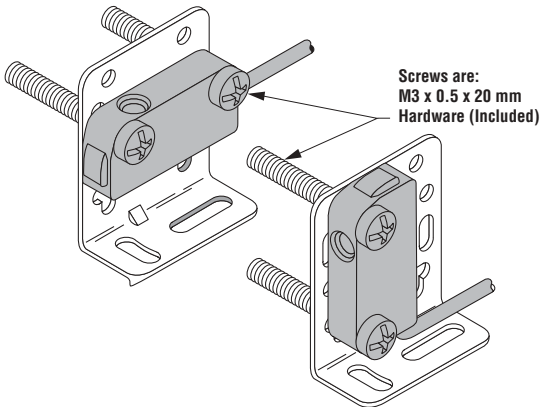
Quick-Disconnect Models



Mounting Bracket (included)



Mounting Orientation



Modifications

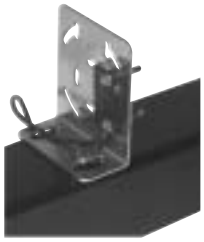
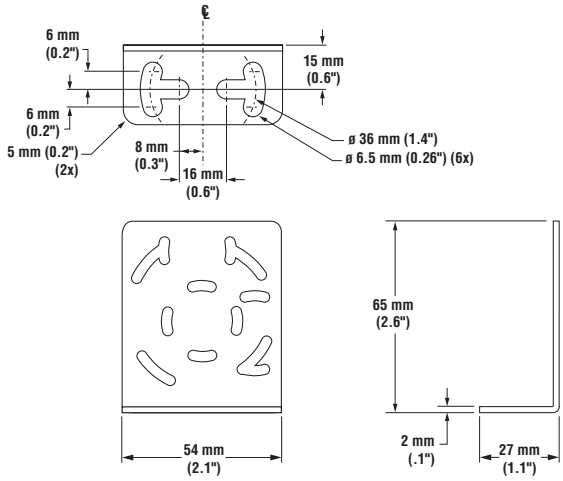
Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All Q14 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	Q14AN6R W/30

Quick-Disconnect (QD) Cables

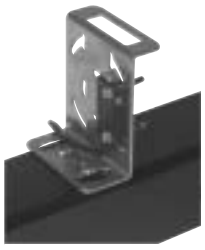
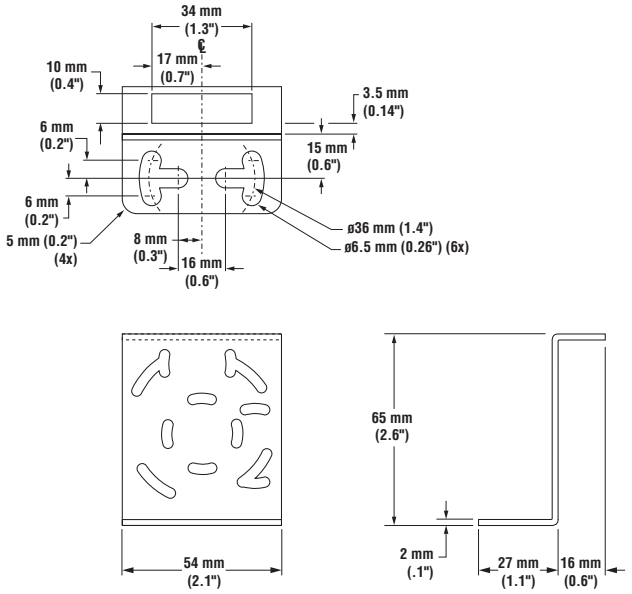
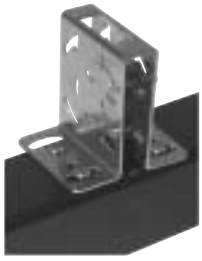
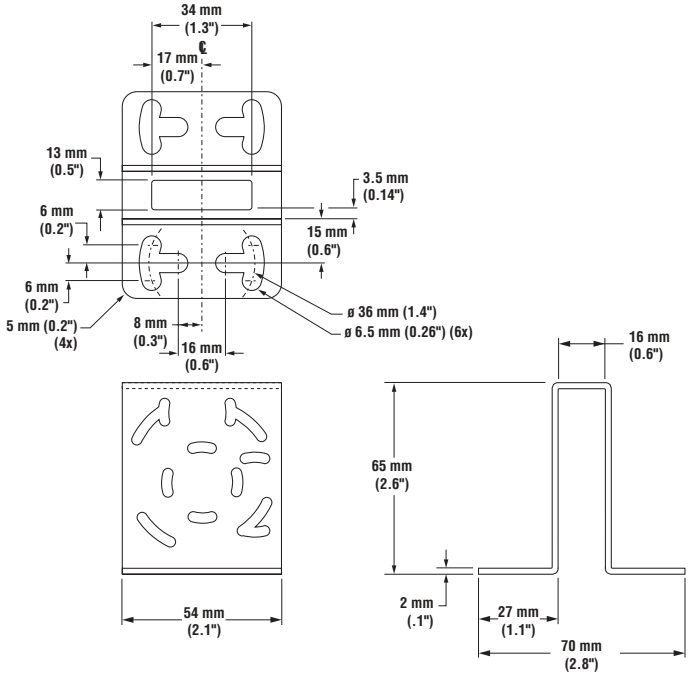
Following is the selection of cables available for Q10 QD models. See the Accessories section at back of catalog for more cable information.

Style	Model	Length	Connector	Used with:
3-Pin Pico	**PKG3-2**	2 m (6.5')	Straight	Q14 with QD fitting

Mounting Brackets

Model	Description	Dimensions
SMB46L 	• "L" bracket • 14-gauge 316 stainless steel	

Mounting Brackets

Model	Description	Dimensions
SMB46S 	• “S” bracket • 14-gauge 316 stainless steel	
SMB46U 	• “U” bracket • 14-gauge 316 stainless steel	

MINI-BEAM® 2 Sensors

Miniature Photoelectric Sensors

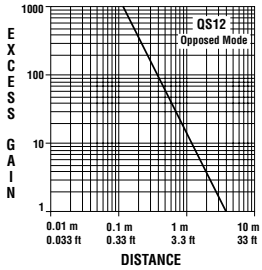
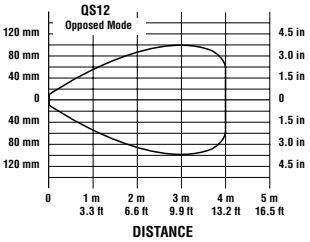
- Designed after the popular MINI-BEAM®, but only one-third the size of the original†.
- 12 mm threaded barrel on most models.
- Uses advanced miniaturized microprocessor-based circuitry.
- Simple setup, using digital push-button sensitivity adjustment.
- Available for opposed, retroreflective, diffuse, and convergent sensing modes.
- 10 to 30V dc operation.
- Complementary outputs (one normally open and one normally closed), each with 150 mA switching capacity.
- IP67 and NEMA 6 environmental ratings.
- Wraparound status indicators.
- Models with either integral, unterminated cable or 150 mm (6") pigtail with 4-pin Pico-style connector.

†Patents issued and pending

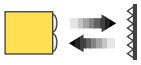
MINI-BEAM2 Sensing Mode Options

Visible red, 660 nm

MINI-BEAM2 Opposed Mode Emitter (E) and Receiver (R)

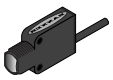
Models	Range	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
QS126E **QS12VN6R**	4 m (13')	2 m (6.5')	10-30V dc	NPN (sinking)		Effective Beam: 5 mm 
QS126EQ **QS12VN6RQ**		4-pin Pico-style Pigtail QD				
QS126E **QS12VP6R**		2 m (6.5')		PNP (sourcing)		
QS126EQ **QS12VP6RQ**		4-pin Pico-style Pigtail QD				

* 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g., **QS12VP6R W/30**). A model with a pigtail QD requires a mating cable (see page 94).

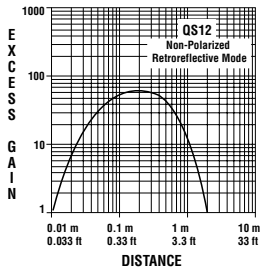
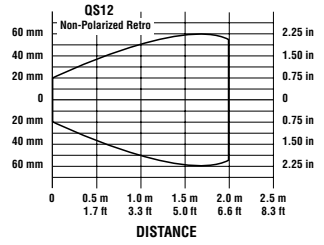
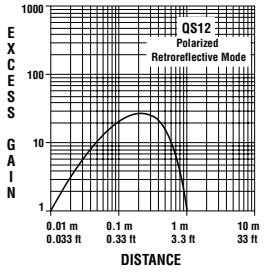
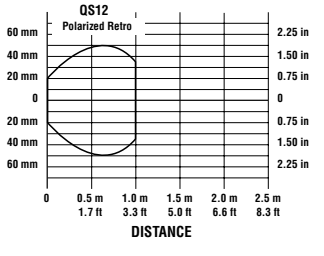


LV: Visible red, 660 nm

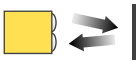
LP: Visible red, 680 nm



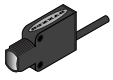
MINI-BEAM2 Retroreflective Mode Sensors

Models	Range**	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on BRT-50 retroreflector	
Retroreflective						
QS12VN6LV	2 m (6.5')	2 m (6.5')	10-30V dc	NPN (sinking)		
QS12VN6LVQ		4-pin Pico-style Pigtail QD				
QS12VP6LV		2 m (6.5')		PNP (sourcing)		
QS12VP6LVQ		4-pin Pico-style Pigtail QD				
Polarized Retroreflective						
QS12VN6LP	1 m (3')	2 m (6.5')	10-30V dc	NPN (sinking)		
QS12VN6LPQ		4-pin Pico-style Pigtail QD				
QS12VP6LP		2 m (6.5')		PNP (sourcing)		
QS12VP6LPQ		4-pin Pico-style Pigtail QD				

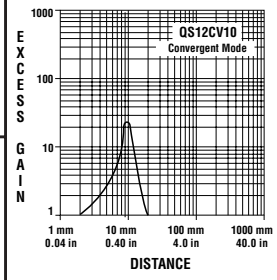
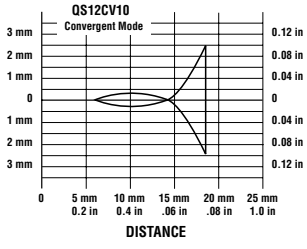
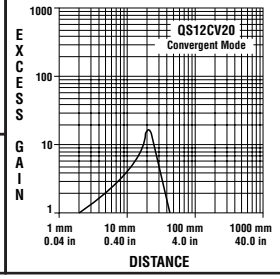
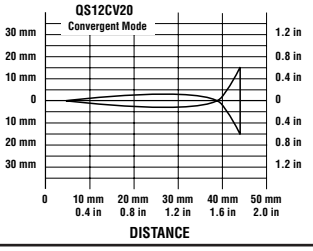
** Range specifications for retroreflective sensors are largely dependent on target size and design. See Accessories section for more information on reflectors.



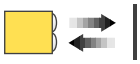
Visible red, 660 nm



MINI-BEAM2 Convergent Mode Sensors

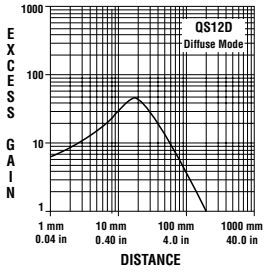
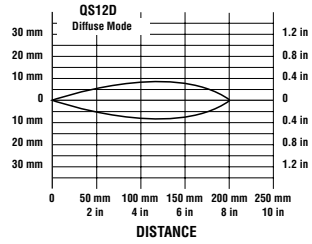
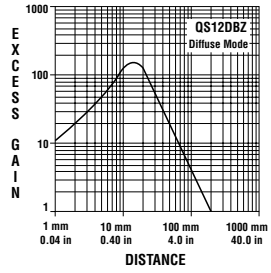
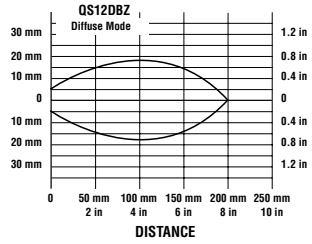
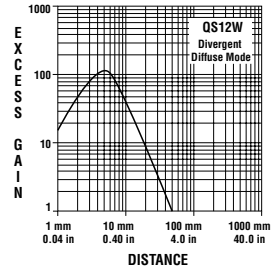
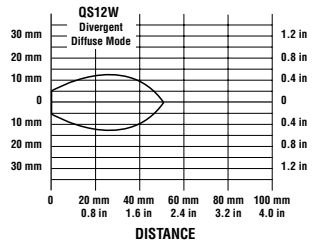
Models	Focus	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Convergent-mode performance based on 90% reflectance white test card	
QS12VN6CV10	10 mm (0.4") **Spot Size at Focus:** 1 mm (0.04")	2 m (6.5')	10-30V dc	NPN (sinking)		
QS12VN6CV10Q		4-pin Pico-style Pigtail QD				
QS12VP6CV10		2 m (6.5')		PNP (sourcing)		
QS12VP6CV10Q		4-pin Pico-style Pigtail QD				
QS12VN6CV20	20 mm (0.8") **Spot Size at Focus:** 1.75 mm (0.07")	2 m (6.5')	10-30V dc	NPN (sinking)		
QS12VN6CV20Q		4-pin Pico-style Pigtail QD				
QS12VP6CV20		2 m (6.5')		PNP (sourcing)		
QS12VP6CV20Q		4-pin Pico-style Pigtail QD				

D Models *DBZ & W Models*



D, DBZ: Visible red, 680 nm
W: Visible red, 660 nm

MINI-BEAM2 Diffuse Mode Sensors

Models	Range	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Diffuse						
QS12VN6D	200 mm (8")	2 m (6.5')	10-30V dc	NPN (sinking)		
QS12VN6DQ		4-pin Pico-style Pigtail QD				
QS12VP6D		2 m (6.5')		PNP (sourcing)		
QS12VP6DQ		4-pin Pico-style Pigtail QD				
Diffuse (Flush-Front Profile)						
QS12VN6DBZ	200 mm (8")	2 m (6.5')	10-30V dc	NPN (sinking)		
QS12VN6DBZQ		4-pin Pico-style Pigtail QD				
QS12VP6DBZ		2 m (6.5')		PNP (sourcing)		
QS12VP6DBZQ		4-pin Pico-style Pigtail QD				
Divergent (Wide-Angle) Diffuse						
QS12VN6W	50 mm (2")	2 m (6.5')	10-30V dc	NPN (sinking)		
QS12VN6WQ		4-pin Pico-style Pigtail QD				
QS12VP6W		2 m (6.5')		PNP (sourcing)		
QS12VP6WQ		4-pin Pico-style Pigtail QD				

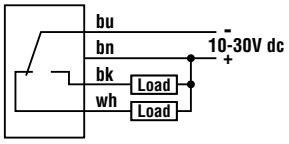
* 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g., **QS12VN6W W/30**). A model with a pigtail QD requires a mating cable (see page 94).

MINI-BEAM2 Specifications

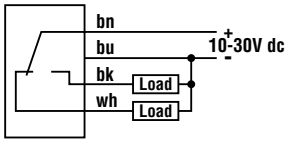
Supply Voltage	10 to 30V dc (10% maximum ripple) at less than 25 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Solid state complementary (SPDT): NPN or PNP (current sinking or sourcing) output models available
Output Rating	150 mA maximum each output at 25°C **OFF-state leakage current:** less than 10 µA @ 30V dc **ON-state saturation voltage:** less than 1V @ 10 mA; less than 2.0V @ 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs
Output Response	**Opposed Mode**: 8 milliseconds ON, 4 milliseconds OFF **All others:** 1.5 milliseconds NOTE: 500 millisecond delay on power-up, outputs do not conduct during this time
Repeatability	**Opposed Mode:** 1 millisecond **All others:** 175 microseconds
Adjustments	One rubber-sealed push button **Hold:** Maximum gain **Click:** Reduce gain one increment
Indicators	2 LEDs, visible from back and sides of sensor: 1 green, 1 amber **Green steady:** Power ON **Amber steady:** Light sensed **Green flashing rapidly 5 times:** Maximum gain **Single green flash:** Click registered, gain reduced by one increment **Amber/Green alternating:** Minimum gain (can not reduce further)
Construction	Black polycarbonate/ABS alloy housing; totally encapsulated circuitry
Environmental Rating	IEC IP67; NEMA 6
Connections	2 m (6.5') 4-wire PVC cable, 9 m (30') PVC cable, or 4-pin Pico-style 150 mm (6") pigtail QD
Operating Conditions	**Temperature:** -20° to +55° C (-4° to +131° F) **Relative Humidity:** 90% @ 50° C (non-condensing)
Certifications	CE c UL us

MINI-BEAM2 Hookups

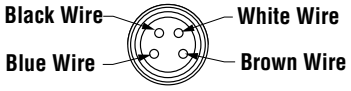
Sensors with NPN (Sinking) Outputs



Sensors with PNP (Sourcing) Outputs

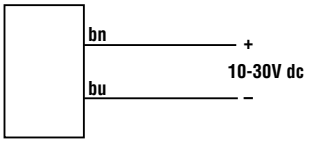


4-Pin Pico-Style Pin-out (Cable Connector Shown)

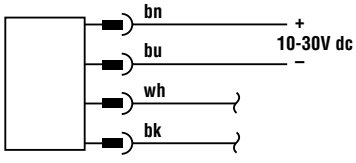


NOTE: Hookups are the same for either an integral or QD cable.

DC Emitters with Attached Cable

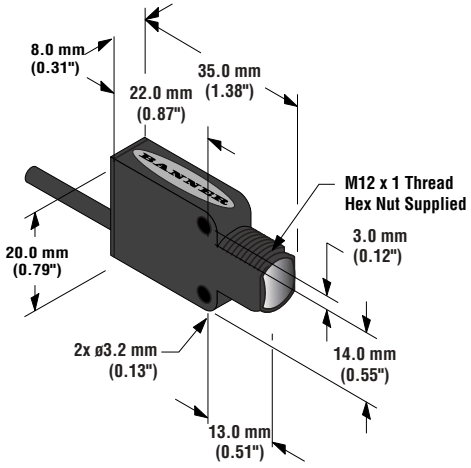


DC Emitters with Quick-Disconnect (4 Pin Pico-Style)

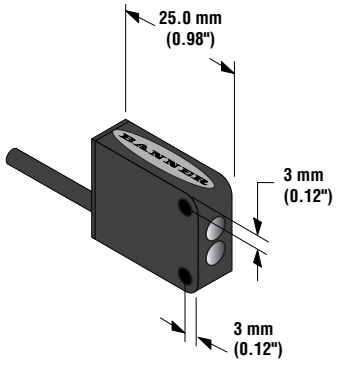


MINI-BEAM2 Dimensions

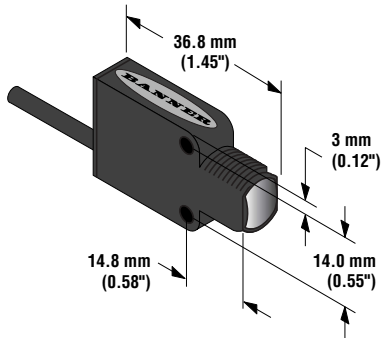
Retroreflective and Diffuse Modes
(Model suffix D, LV and LP)



Divergent Diffuse Modes
(Model suffix DBZ and W)



Emitter, Receiver, Convergent
(Model suffix E, R, and CV)



Accessories

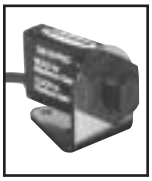
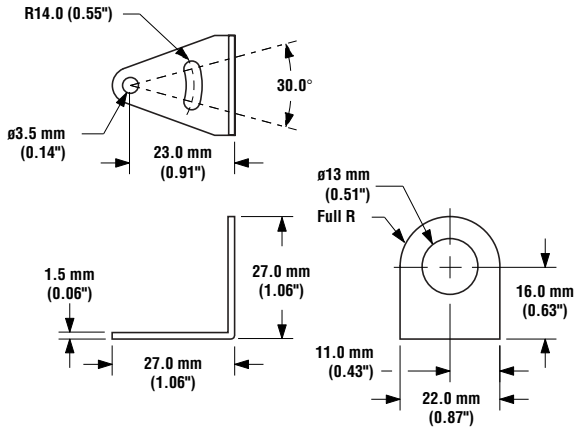
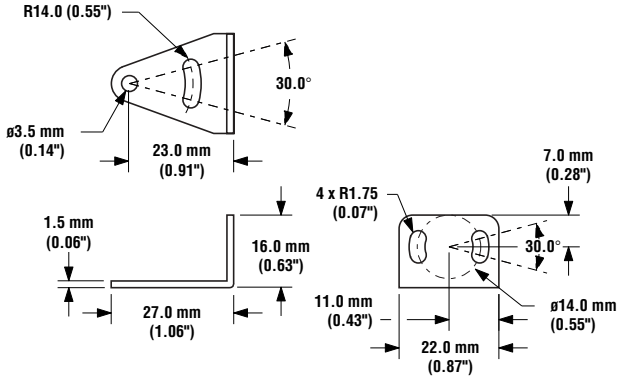
Quick-Disconnect (QD) Cables

Style	Model	Length	Connector	For use with
4-Pin Pico	**PKG4-2**	2 m (6.5')	Straight	All MINI-BEAM2 sensors with pigtail QD

Retroreflective Targets

Banner offers a wide selection of high-quality retroreflective targets. See Accessories section for complete information.

Mounting Brackets

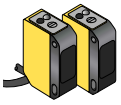
Model	Description	Dimensions
SMBQS12PD 	• Right-angle bracket, 12 mm nose-mount • 300 series stainless steel, 16 ga.	
SMBQS12S 	• Right-angle bracket, side-mount • 300 series stainless steel, 16 ga.	

Q23 & QH23 Sensors

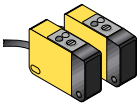
Miniature Photoelectric Sensors

- 10 to 30V dc operation
- Choose NPN (sinking) or PNP (sourcing) models; outputs are short circuit protected and rated for up to 150 milliamp load
- LED indications for Power ON, Output Status (including overload condition), Alignment and Marginal Signal
- 2 m (6.5') integral cable length is standard; 9 m (30') cable is also available
- Models with quick-disconnect have 150 mm (6") pico-style pigtail connector; mating cables are ordered separately
- Stainless steel right-angle mounting bracket and hardware are included (see pages 102 and 103)

Q23 & QH23 Sensing Mode Options



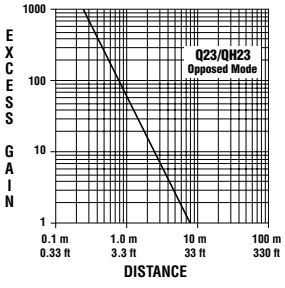
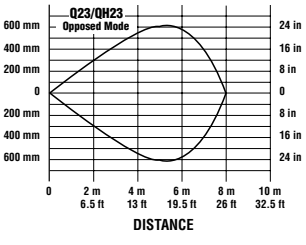
Q23



QH23

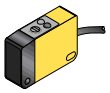
Visible red, 680 nm

Q23 & QH23 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q236E **QH236E** **Q236EQ** **QH236EQ**	8 m (26')	2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD	10-30V dc	–		Effective Beam: 5.3 mm 
Q23SN6R **QH23SN6R** **Q23SN6RQ** **QH23SN6RQ**		2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD		Comple-mentary Solid-state NPN		
Q23SP6R **QH23SP6R** **Q23SP6RQ** **QH23SP6RQ**		2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD		Comple-mentary Solid-state PNP		

Visible red, 680 nm

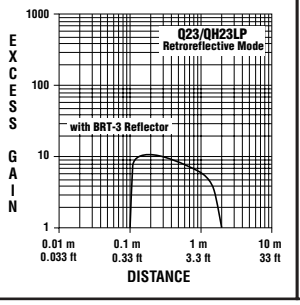
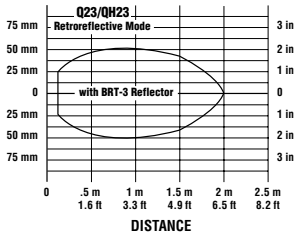
NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

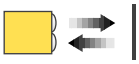


QH23

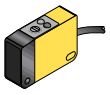
Q23

Q23 & QH23 Polarized Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q23SN6LP **QH23SN6LP** **Q23SN6LPQ** **QH23SN6LPQ**	100 mm to 2 m (4 to 80")	2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD	10-30V dc	Complementary Solid-state NPN		
Q23SP6LP **QH23SP6LP** **Q23SP6LPQ** **QH23SP6LPQ**		2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD		Complementary Solid-state PNP		



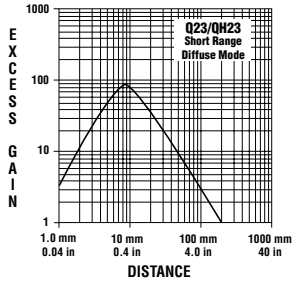
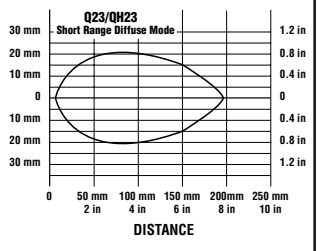
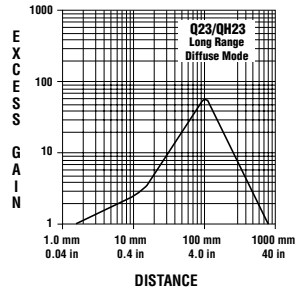
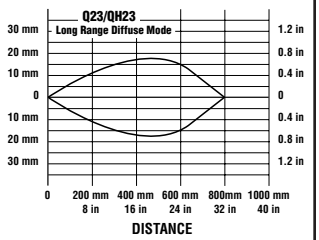
Visible red, 680 nm



QH23

Q23

Q23 & QH23 Diffuse Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Short Range						
Q23SN6D **QH23SN6D** **Q23SN6DQ** **QH23SN6DQ**	Optimum: 2 - 50 mm (.1 - 2")	2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD	10-30V dc	Complementary Solid-state NPN		
Q23SP6D **QH23SP6D** **Q23SP6DQ** **QH23SP6DQ**	Maximum: 200 mm (8")	2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD		Complementary Solid-state PNP		
Long Range						
Q23SN6DL **QH23SN6DL** **Q23SN6DLQ** **QH23SN6DLQ**	Optimum: 30 to 300 mm (1.2 to 12")	2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD	10-30V dc	Complementary Solid-state NPN		
Q23SP6DL **QH23SP6DL** **Q23SP6DLQ** **QH23SP6DLQ**	Maximum: 800 mm (32")	2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD		Complementary Solid-state PNP		

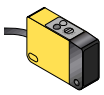
For All Q23 & QH23 Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q23SN6LP W/30**)

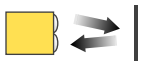
ii) All Q23 QD models have a 4-pin pico-style connector on a 150 mm (6") cable pigtail.

iii) A model with a QD connector requires an accessory mating cable. See Accessories for more information.

Q23

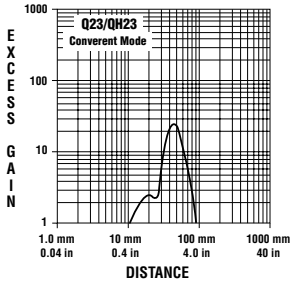
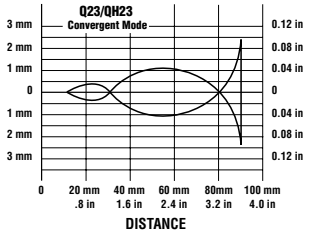


QH23



Visible red, 680 nm

Q23 & QH23 Convergent

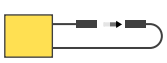
Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q23SN6CV50 **QH23SN6CV50** **Q23SN6CV50Q** **QH23SN6CV50Q**	50 mm (2 in)	2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD	10-30V dc	Comple-mentary Solid-state NPN		
Q23SP6CV50 **QH23SP6CV50** **Q23SP6CV50Q** **QH23SP6CV50Q**		2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD		Comple-mentary Solid-state PNP		

For ALL Q23 & QH23 Sensors:

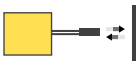
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q23SN6CV50 W/30**)

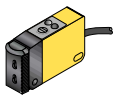
ii) All Q23 QD models have a 4-pin pico-style connector on a 150 mm (6") cable pigtail.

iii) A model with a QD connector requires an accessory mating cable. See page 103 and the Accessories section for more information.

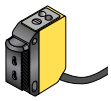


Visible red, 680 nm



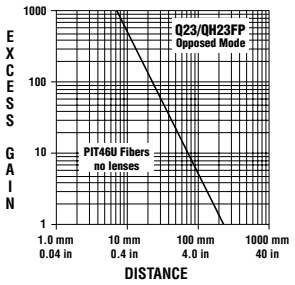
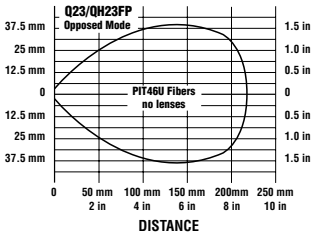
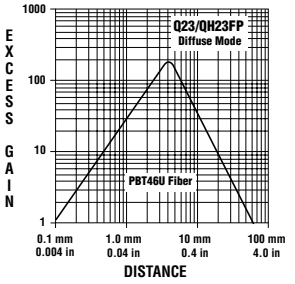
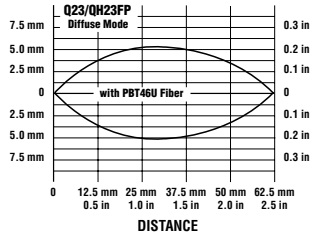
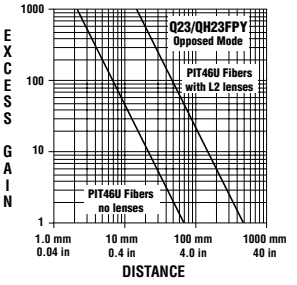
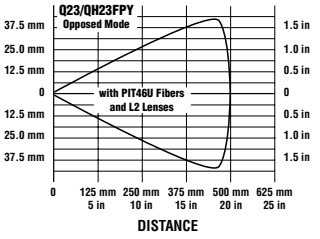
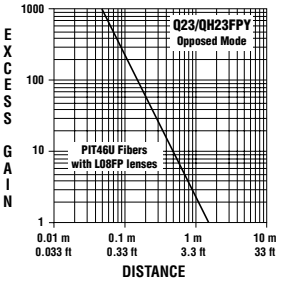
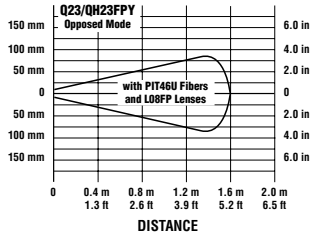


QH23



Q23

Q23 & QH23 Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Standard Speed: 1 ms Response						
Q23SN6FP **QH23SN6FP** **Q23SN6FPQ** **QH23SN6FPQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD	10-30V dc	Comple-mentary Solid-state NPN		
Q23SP6FP **QH23SP6FP** **Q23SP6FPQ** **QH23SP6FPQ**		2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD		Comple-mentary Solid-state PNP		
High Speed: 100 µs Response						
Q23SN6FPY **QH23SN6FPY** **Q23SN6FPYQ** **QH23SN6FPYQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD	10-30V dc	Comple-mentary Solid-state NPN		
Q23SP6FPY **QH23SP6FPY** **Q23SP6FPYQ** **QH23SP6FPYQ**		2 m (6.5') 2 m (6.5') 4-Pin Pico Pigtail QD 4-Pin Pico Pigtail QD		Comple-mentary Solid-state PNP		

For Q23 & QH23 Plastic Fiber Sensing Mode:

i) The opposed range of Q23FP sensors using 1mm (0.4") plastic fibers may be extended using optional lens pairs. A pair of model L2 lenses extends the opposed range to 2 m (80"). A pair of model L08FP lenses extends opposed range to 3 m (10'). See page 673 for lens details.

ii) Diffuse mode sensing with Q23FPY models is generally not recommended due to low excess gain. If in doubt about sensing performance, contact the factory Application Engineering Department or your local Banner Sales Engineer to discuss diffuse mode applications.

Q23 & QH23 Specifications

Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 25 mA for diffuse, retro, and fiber optic models (exclusive of load) Opposed emitters and receivers draw 20 mA each
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Solid-state dc complementary outputs: Q(H)23SN6xx models = NPN sinking, N.O. (normally open) & N.C. (normally closed) complementary Q(H)23SP6xx models = PNP sourcing, N.O. & N.C. complementary Light operate: N.O. output conducts when the sensor sees its own modulated light source Dark operate: N.C. output conducts when the sensing beam is blocked The N.C. output may be used as an alarm output, depending upon hookup to the power supply (see hookup diagrams)
Output Rating	150 mA maximum each in standard hookup; when wired for alarm output, the total load may not exceed 150 mA **Off-state leakage current** less than 1 microamp at 30V dc **Output saturation voltage** less than 1 volt at 10mA dc; less than 1.5V at 150 mA dc
Output Protection Circuitry	Protected against false pulse on power-up, transient voltages, and continuous overload or short-circuit of outputs
Output Response Time	1 millisecond "ON" and "OFF" (except for Q23FPY high-speed sensors which have 100 microsecond response time); no false pulse on power-up (NOTE: 100 millisecond delay on power-up: outputs are non-conducting during this time.)
Repeatability	**All Opposed Modes:** 0.13 ms; **Retro and Diffuse:** 0.25 ms; **FPY High speed Plastic Fiber Optic:** 25 microseconds. Response time and repeatability specifications are independent of signal strength.
Adjustments	SENSITIVITY control (single-turn, o-ring sealed potentiometer)
Indicators	Sensors except opposed mode emitters have two LEDs: GREEN glowing steadily = dc power "ON" GREEN flashing = output overload YELLOW glowing steadily = normally open output is conducting YELLOW flashing = marginal excess gain (1 - 1.5x), light condition; flashing YELLOW corresponds to "ON" state of alarm output Emitters have green power "ON" indicator
Construction	Yellow and black ABS housing, with acrylic lenses, completely sealed. Stainless steel mounting bracket and M3 mounting hardware are supplied
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 12, and 13; IEC IP67. Housing materials rated UL 94 V-0
Connections	PVC-jacketed 4-conductor 2 m (6.5') or 9 m (30') cables, or 6" pigtail with 4-pin pico-style quick-disconnect (QD) fitting are available. Mating QD cables are ordered separately. See Accessories.
Operating Conditions	**Temperature:** -20° to +55°C (-5° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Note	To avoid damage to the sensor caused by static discharge (ESD), use the plastic screwdriver supplied with each sensor (included in the hardware packet) to adjust the SENSITIVITY control. Otherwise, use a screwdriver with an insulated handle.
Certifications	CE c UL us

Quick-Disconnect (QD) Option

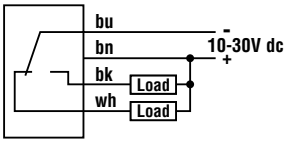
Q23 & QH23 sensors are sold either with a 2 m (6.5') or 9 m (30') attached PVC-covered cable or with a 4-pin pico-style QD connector on a 150 mm (6") cable pigtail.

Q23 & QH23 QD sensors are identified by the letter "Q" in their model number suffix. Mating cables for QD sensors are model PKG4-2 (straight connector) or PKW4-2 (right-angled connector). Cables are supplied in a standard length of 2 m (6.5'). For more information on QD cable, see page 103 and the Accessories section.

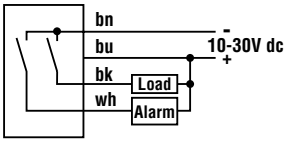
Q23 & QH23 Hookup Diagrams

Sensors with NPN (Sinking) Outputs

Standard Hookup

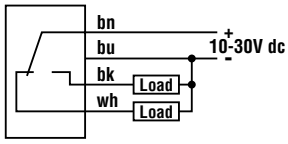


Alarm Hookup

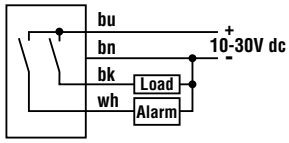


Sensors with PNP (Sourcing) Outputs

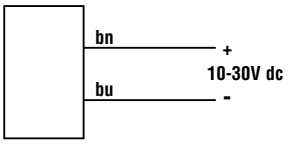
Standard Hookup



Alarm Hookup

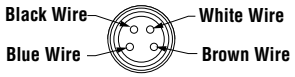


Emitters



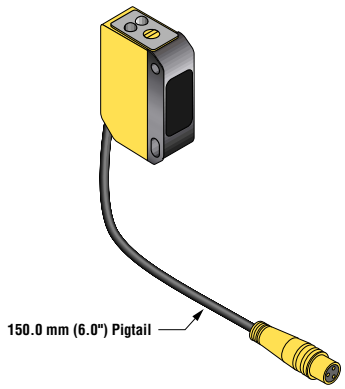
Note: No connection to bk and wh wires of QD cable.

4-Pin Pico-Style Pin-out (Connector on Cable Shown)

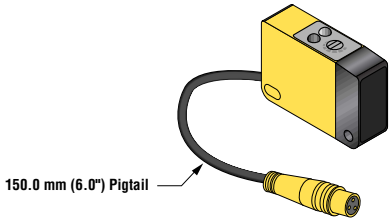


NOTE: Hookups are the same for either an integral or QD cable.

Q23 Pigtail Quick-Disconnect

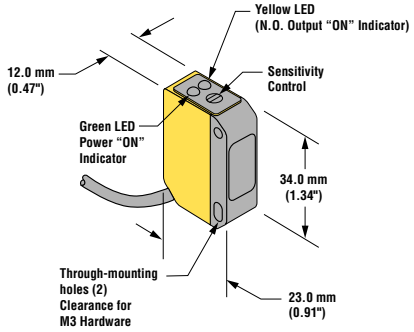


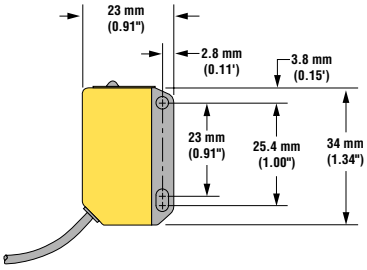
QH23 Pigtail Quick-Disconnect



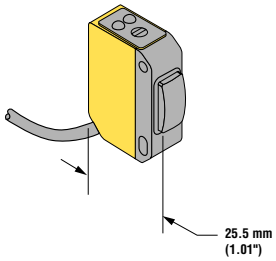
Q23 Dimensions

Q23 Sensor - Opposed, Diffuse, Convergent, and Retroreflective Modes (model suffix E, R, D, DL & LP)



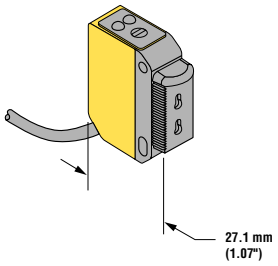


Q23 Sensor - Convergent Mode (model suffix CV)

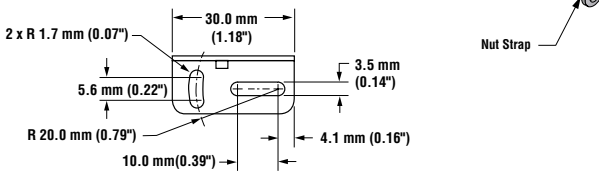


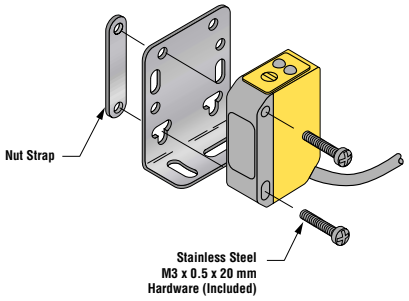
Q23 Dimensions

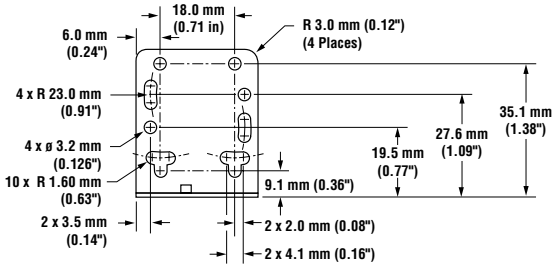
Q23 Sensor - Plastic Fiber Optic (model suffix FP & FPY)

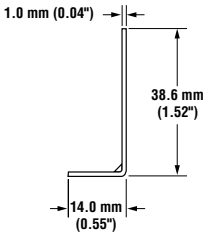


Q23 Mounting Bracket (included with sensor)



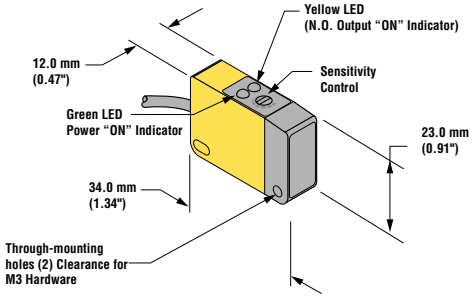


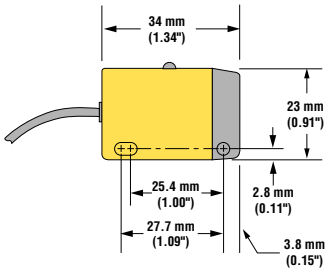




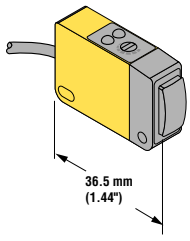
QH23 Dimensions

QH23 Sensor - Opposed, Diffuse, Convergent, and Retroreflective Modes (model suffix E, R, D, DL & LP)

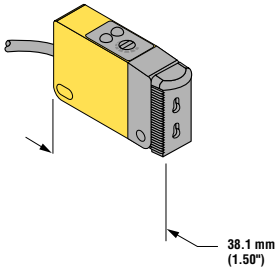




QH23 Sensor - Convergent Mode (model suffix CV)

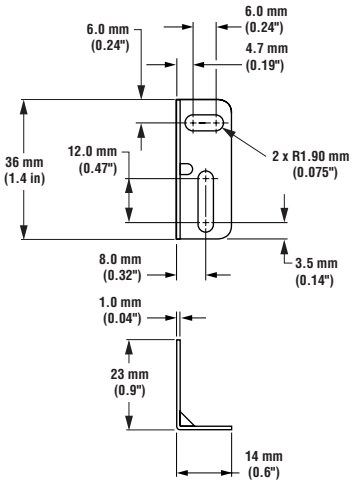


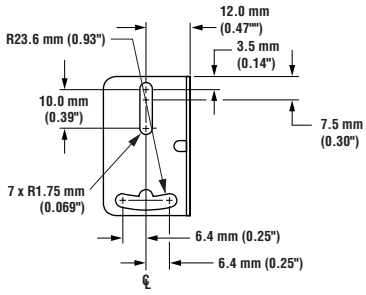
QH23 Sensor - Plastic Fiber Optic (model suffix FP & FPY)

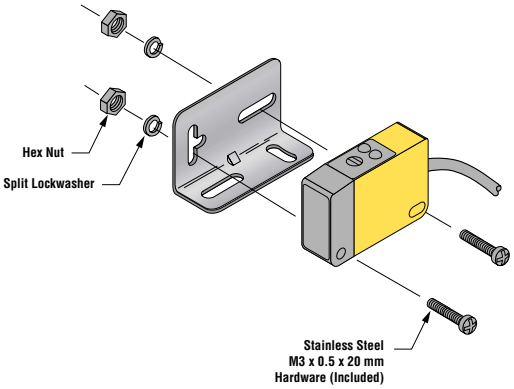


QH23 Dimensions

QH23 Mounting Bracket
(included with sensor)







Accessories

Modifications

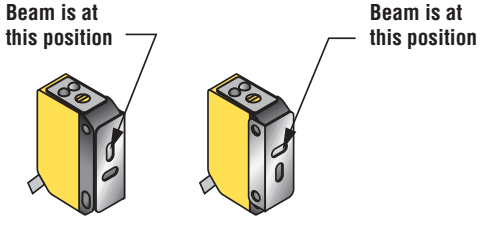
Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All Q23 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	Q23SP6D W/30

Quick-Disconnect (QD) Cables

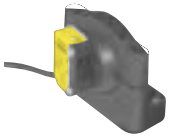
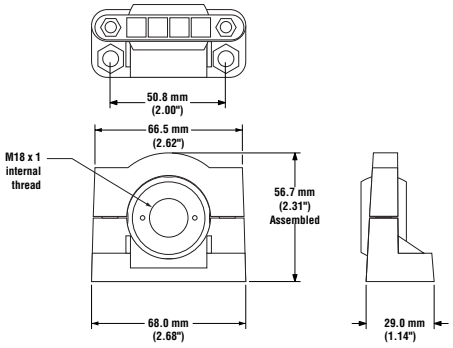
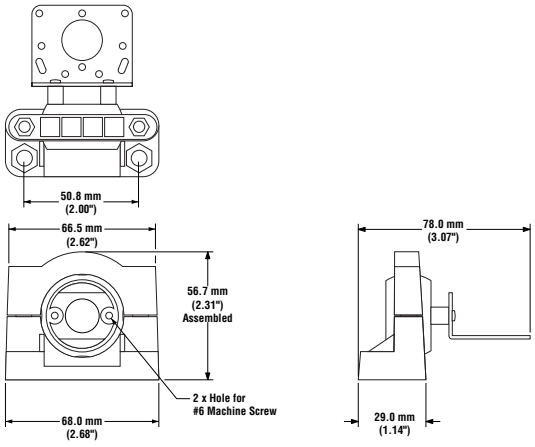
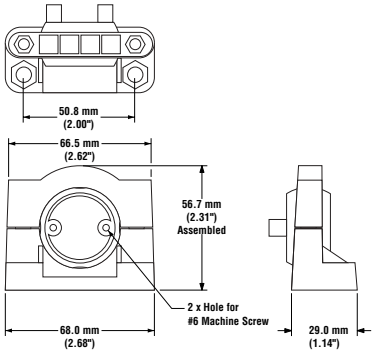
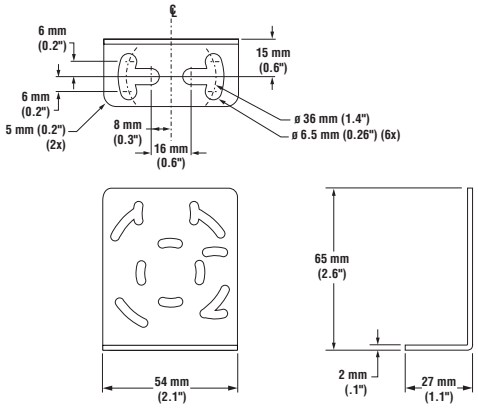
Style	Model	Length	Connector	For use with
4-Pin Pico	**PKG4-2**	2 m (6.5')	Straight	All Q23 & QH23 sensors with pigtail QD

Apertures

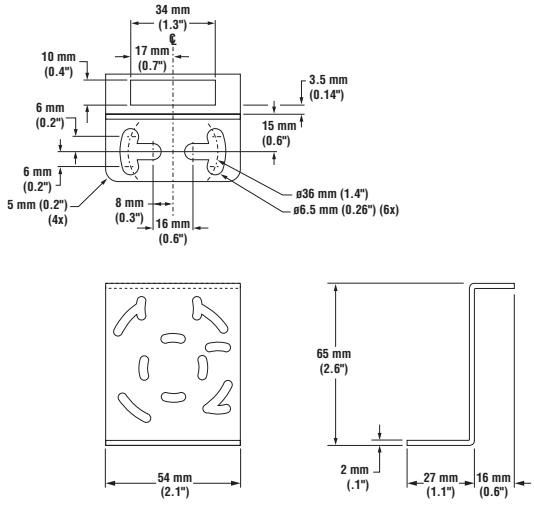
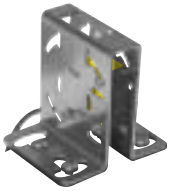
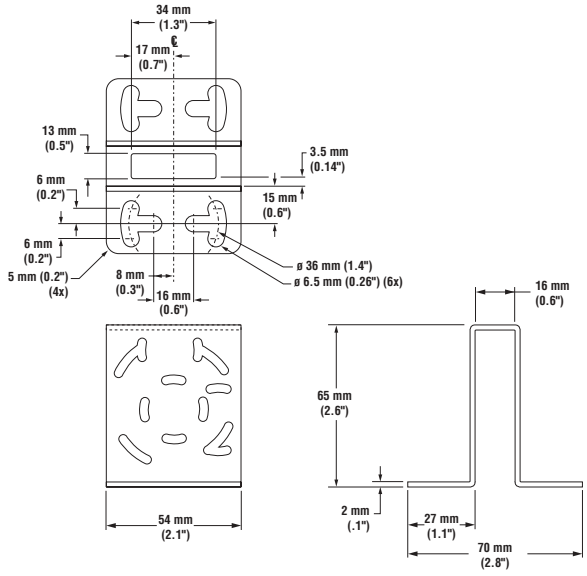
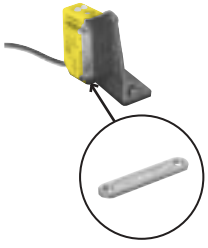
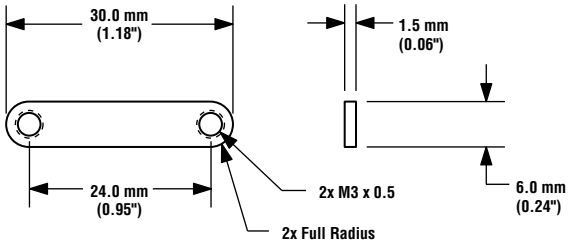
Q23 opposed mode sensors may be fitted with apertures which narrow or shape the effective beam of the sensor to more closely match the size or profile of the object to be sensed. This will reduce the sensing range of the particular sensors. Q23 apertures use M3 hardware which is provided with the SMB23 mounting bracket and with all Q23 models. Slotted apertures have a vertical and horizontal slot of equal width. Round apertures have two circular holes of different diameters.

Model	Aperture Shape	Aperture Size	Dimensions
AP19-00	Blank	Blank	
AP23-04S **AP23-06S** **AP23-10S** **AP23-12S**	Slot	1.0 mm (0.04") 1.5 mm (0.06") 2.5 mm (0.10") 3.0 mm (0.12")	
AP23-0203 **AP23-0404** **AP23-0406** **AP23-1012**	Round	ø 0.5 mm (0.02") & 0.8 mm (0.03") ø 1.0 mm (0.04") & 1.0 mm (0.04") ø 1.0 mm (0.04") & 1.5 mm (0.06") ø 2.5 mm (0.10") & 3.0 mm (0.12")	

Mounting Brackets

Model	Description	Dimensions
SMB3018SC 	• For use with Q23 Series • 18 mm swivel barrel or side mount bracket • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB30SK 	• For use with Q23 or QH23 Series • Flat-mount swivel bracket with extended range of motion • Black reinforced thermoplastic polyester and 316 stainless steel • Includes stainless steel swivel locking hardware	
SMB30SUS 	• For use with Q23 Series • Side mount swivel bracket – extended range of motion • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB46L 	• For use with Q23 or QH23 Series • "L" bracket • 14-gauge 316 stainless steel	

Mounting Brackets

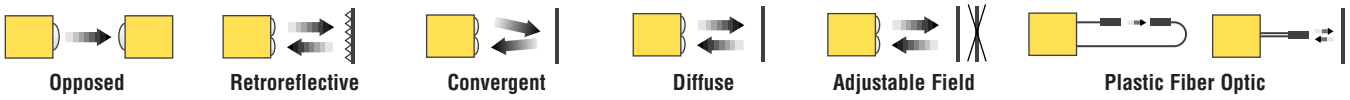
Model	Description	Dimensions
SMB46S 	• For use with Q23 or QH23 Series • "S" bracket • 14-gauge 316 stainless steel	
SMB46U 	• For use with Q23 or QH23 Series • "U" bracket • 14-gauge 316 stainless steel	
SMB46U 	• For use with Q23 Series • Nut Strap replaces two M3 mounting nuts and washers • 16-gauge stainless steel	

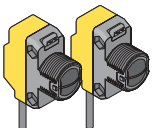
WORLD-BEAM™ Sensors

Miniature Self-Contained Photoelectric Sensors in Universal Housing

- Easily fits (or retrofits) almost any mounting situation
- Exceptional optical performance, comparable to larger “mini-style” or barrel sensors
- 10 to 30V dc operation, with complementary (SPDT) NPN or PNP outputs, depending on model
- Bright LED operating status indicators are visible from 360°
- Rugged sealed housing, protected circuitry
- Models available with or without 18 mm threaded “nose”
- All models less than 1 millisecond output response for excellent sensing repeatability
- Integral Euro- or Pico-style quick-disconnect models plus Euro- or Pico-style pigtail models, are available (see page 112)

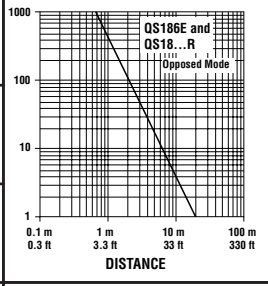
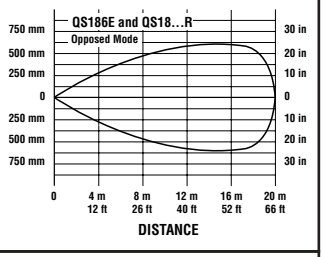
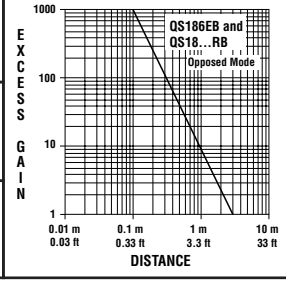
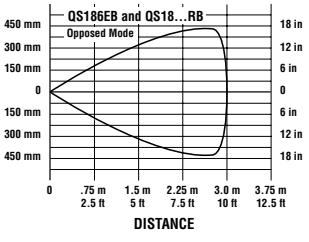
WORLD-BEAM Sensing Mode Options



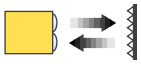


Infrared, 940 nm

WORLD-BEAM Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
QS186E	20 m (66’)	2 m (6.5') 2-wire	10 to 30V dc	N/A		Effective Beam: 13 mm (0.5") 
QS186EQ		4-pin Pico Pigtail QD				
QS18VN6R		2 m (6.5') 4-wire		NPN		
QS18VN6RQ		4-pin Pico Pigtail QD				
QS18VP6R		2 m (6.5') 4-wire		PNP		
QS18VP6RQ		4-pin Pico Pigtail QD				
QS186EB	3 m (10’)	2 m (6.5') 2-wire		N/A		Effective Beam: 13 mm (0.5") 
QS186EBQ		4-pin Pico Pigtail QD				
QS18VN6RB		2 m (6.5') 4-wire		NPN		
QS18VN6RBQ		4-pin Pico Pigtail QD				
QS18VP6RB		2 m (6.5') 4-wire		PNP		
QS18VP6RBQ		4-pin Pico Pigtail QD				

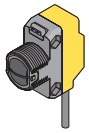
* Note: QS18 sensors (except model suffix **AF100**) are available with the following quick-disconnect variations (see page 112 for information): model suffix **Q5**: 4-pin pigtail Euro QD; model suffix **Q7**: 4-pin integral Pico QD; and model suffix **Q8**: 4-pin integral Euro QD. A model with a QD connector requires an accessory mating cable. See page 112 and the Accessories section for more information.



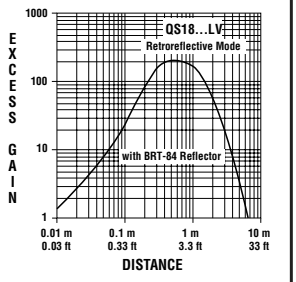
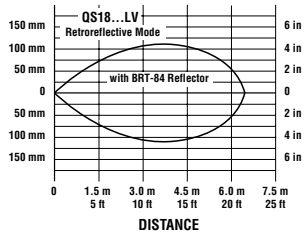
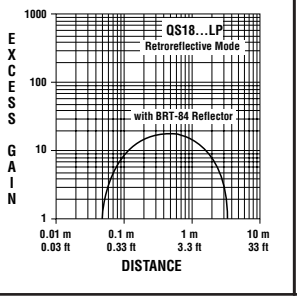
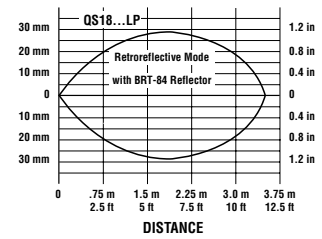
LV: Visible red, 660 nm

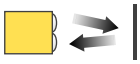
LP: Visible red, 660 nm

NOTE: Retroreflective range is specified using one model BRT-84 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



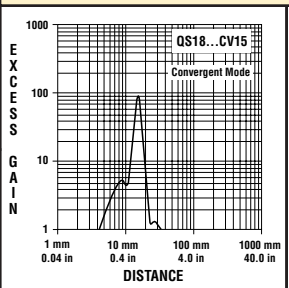
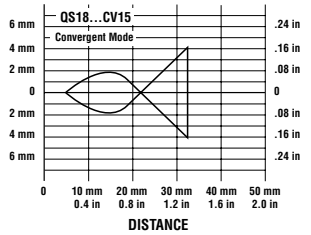
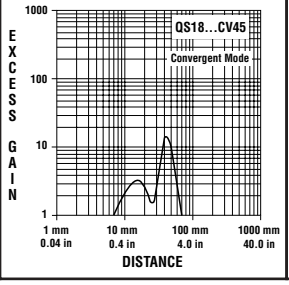
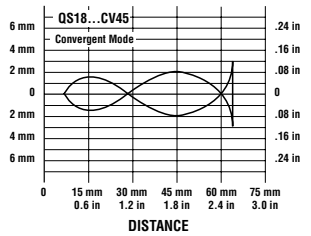
WORLD-BEAM Retroreflective Mode

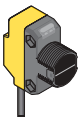
Models	Range	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Retroreflective						
QS18VN6LV	6.5 m (21')	2 m (6.5') 4-wire	10 to 30V dc	NPN		
QS18VN6LVQ		4-pin Pico Pigtail QD				
QS18VP6LV		2 m (6.5') 4-wire		PNP		
QS18VP6LVQ		4-pin Pico Pigtail QD				
Polarized Retroreflective						
QS18VN6LP	3.5 m (12')	2 m (6.5') 4-wire	10 to 30V dc	NPN		
QS18VN6LPQ		4-pin Pico Pigtail QD				
QS18VP6LP		2 m (6.5') 4-wire		PNP		
QS18VP6LPQ		4-pin Pico Pigtail QD				

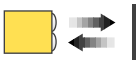


Visible red, 660 nm

WORLD-BEAM Convergent Mode

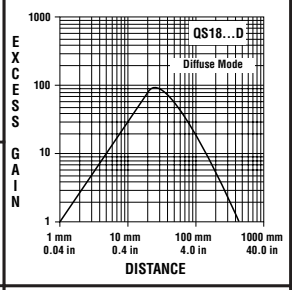
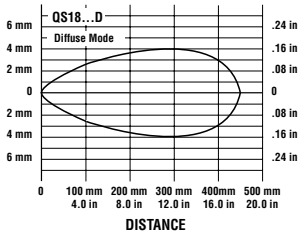
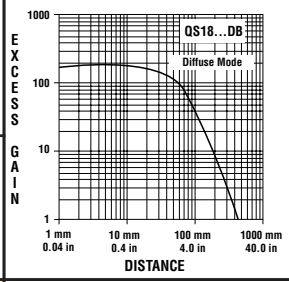
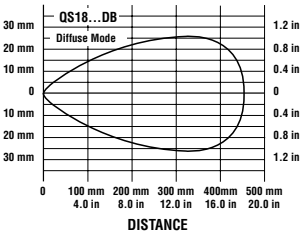
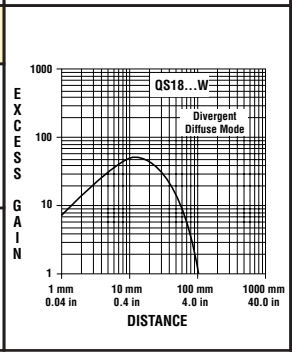
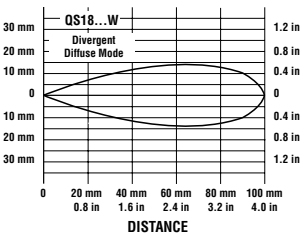
Models	Range	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
QS18VN6CV15	16 mm (0.63")	2 m (6.5') 4-wire	10 to 30V dc	NPN		
QS18VN6CV15Q		4-pin Pico Pigtail QD				
QS18VP6CV15		2 m (6.5') 4-wire		PNP		
QS18VP6CV15Q		4-pin Pico Pigtail QD				
QS18VN6CV45	43 mm (1.7")	2 m (6.5') 4-wire	10 to 30V dc	NPN		
QS18VN6CV45Q		4-pin Pico Pigtail QD				
QS18VP6CV45		2 m (6.5') 4-wire		PNP		
QS18VP6CV45Q		4-pin Pico Pigtail QD				



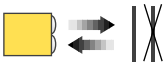


Infrared, 940 nm

WORLD-BEAM Diffuse Mode

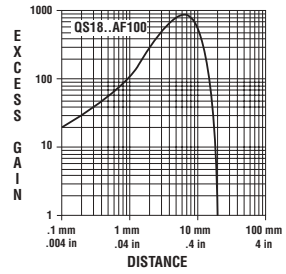
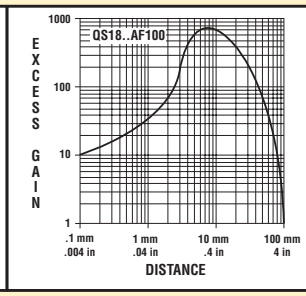
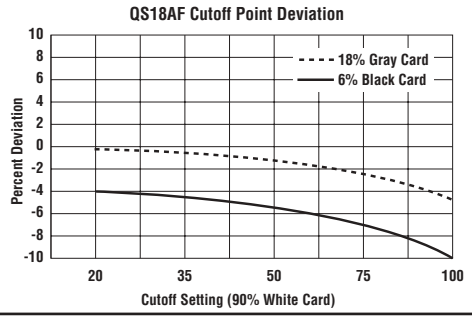
Models	Range	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
QS18VN6D	450 mm (18")	2 m (6.5') 4-wire	10 to 30V dc	NPN		
QS18VN6DQ		4-pin Pico Pigtail QD				
QS18VP6D		2 m (6.5') 4-wire		PNP		
QS18VP6DQ		4-pin Pico Pigtail QD				
QS18VN6DB		2 m (6.5') 4-wire	10 to 30V dc	NPN		
QS18VN6DBQ		4-pin Pico Pigtail QD				
QS18VP6DB		2 m (6.5') 4-wire		PNP		
QS18VP6DBQ		4-pin Pico Pigtail QD				
Divergent Diffuse						
QS18VN6W	100 mm (4")	2 m (6.5') 4-wire	10 to 30V dc	NPN		
QS18VN6WQ		4-pin Pico Pigtail QD				
QS18VP6W		2 m (6.5') 4-wire		PNP		
QS18VP6WQ		4-pin Pico Pigtail QD				

* Note: QS18 sensors (except model suffix **AF100**) are available with the following quick-disconnect variations (see page 112 for information): model suffix **Q5**: 4-pin pigtail Euro QD; model suffix **Q7**: 4-pin integral Pico QD; and model suffix **Q8**: 4-pin integral Euro QD. A model with a QD connector requires an accessory mating cable. See page 112 and the Accessories section for more information.

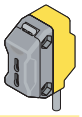


Visible red, 660 nm

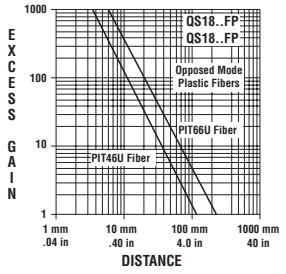
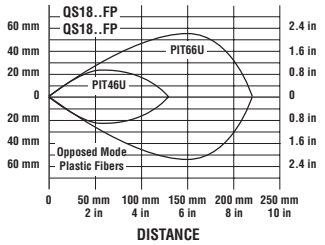
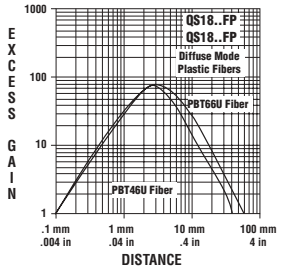
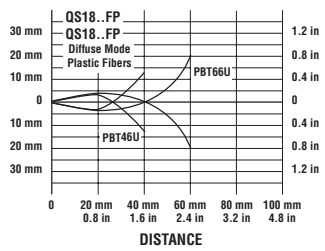
WORLD-BEAM Adjustable Field Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain at 20 mm Cutoff	Excess Gain at 100 mm Cutoff
					Performance based on 90% reflectance white test card	
QS18VN6AF100	1 mm (0.04") to cutoff point (cutoff point adjustable between 20-100 mm)	2 m (6.5') 4-wire	10 to 30V dc	NPN		
QS18VN6AF100Q		4-pin Pico Pigtail QD				
QS18VP6AF100		2 m (6.5') 4-wire		PNP	Cutoff Point Deviation	
QS18VP6AF100Q		4-pin Pico Pigtail QD				

Visible red, 660 nm



WORLD-BEAM Plastic Fiber Optic Mode

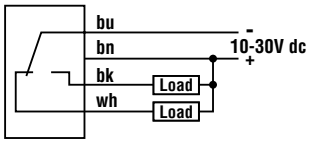
Models	Range	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
QS18VN6FP	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-wire	10 to 30V dc	NPN		
QS18VN6FPQ		4-pin Pico Pigtail QD				
QS18VP6FP		2 m (6.5') 4-wire		PNP		
QS18VP6FPQ		4-pin Pico Pigtail QD				

WORLD-BEAM Specifications

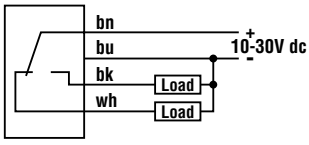
Supply Voltage	10 to 30V dc (10% maximum ripple) at less than 25 mA, exclusive of load; Protected against reverse polarity and transient voltages
Output Configuration	**Solid-state complementary (SPDT);** NPN or PNP (current sinking or sourcing), depending on model; **Rating:** 100 mA maximum each output at 25°C **Off-state leakage current:** less than 50 µA @ 30V dc **ON-state saturation voltage:** less than 1V @ 10 mA; less than 1.5V @ 100 mA Protected against false pulse on power-up and continuous overload or short circuit of outputs
Output Response	**Opposed Mode:** 750 microseconds ON; 375 microseconds OFF **Adjustable Field Mode:** 700 microseconds ON/OFF **All others:** 600 microseconds ON/OFF NOTE: 100 millisecond delay on power-up; outputs do not conduct during this time
Repeatability	**Opposed Mode:** 100 microseconds **Adjustable Field Mode:** 175 microseconds **All others:** 150 microseconds
Adjustments	**Convergent, diffuse, and retroreflective mode models (only):** Single-turn sensitivity (GAIN) adjustment potentiometer **Adjustable Field models (only):** multi-turn adjustment screw sets cutoff distance between 20 and 100 mm
Indicators	2 LED indicators: **Green steady:** Power ON **Green flashing:** Output overloaded **Red steady:** Light sensed **Red flashing:** Marginal excess gain
Construction	Polycarbonate/ABS alloy housing, rated IEC IP67; NEMA 6 3 mm mounting hardware included
Connections	2 m (6.5') 4-wire PVC cable, 9 m (30') PVC cable, or 4-pin integral Euro-style Pigtail QD, or 4-in Pico-style 150 mm (6") pigtail QD, depending on model
Operating Conditions	**Temperature for Adjustable Field Mode:** 0° to +55°C (+32° to +131°F) **Temperature for All Other Modes:** -20° to +70° C (-4° to + 158° F) **Relative Humidity:** 90% @ 50° C (non-condensing)

WORLD-BEAM Hookups

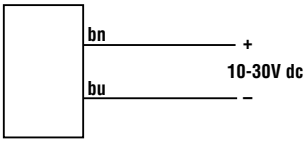
QS18 Sensors with NPN (Sinking) Outputs



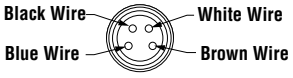
QS18 Sensors with PNP (Sourcing) Outputs



QS18 Emitters

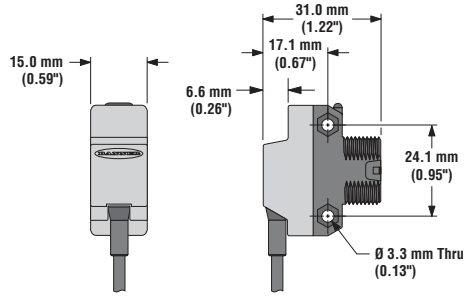


4-Pin Pico-Style Pin-out (Cable Connector Shown)

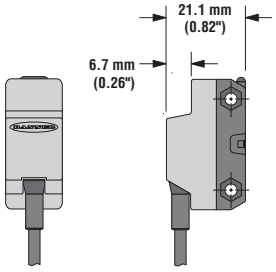


WORLD-BEAM Dimensions and Features

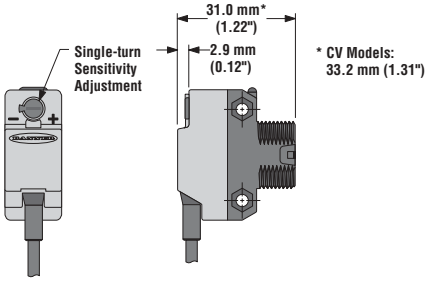
Opposed Mode (model suffix E & R)



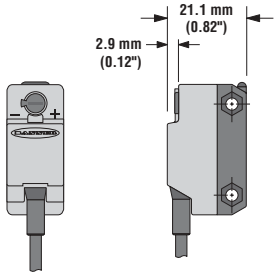
Opposed Mode (model suffix EB & RB)



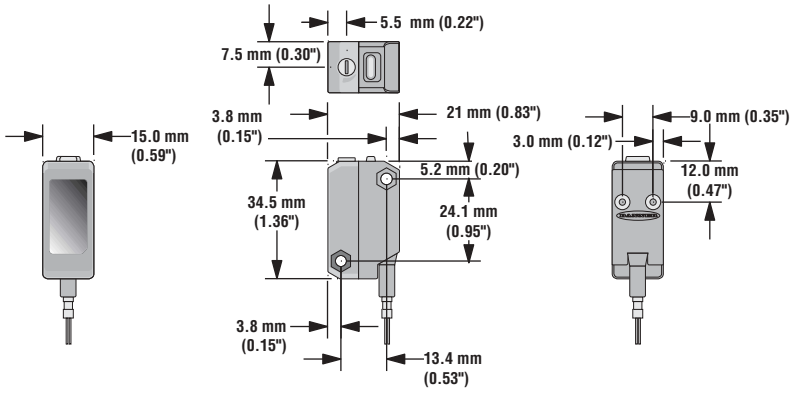
Convergent, Diffuse and Retroreflective Modes (model suffix CV15, CV45, D, LV & LP)



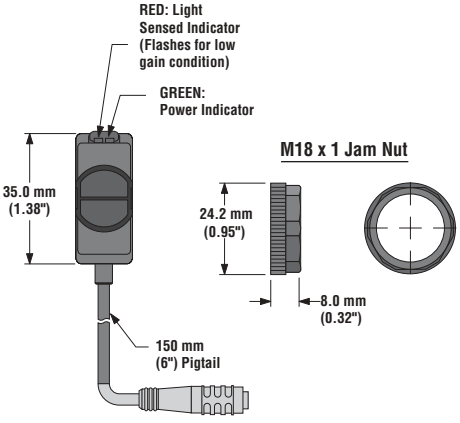
Diffuse and Divergent Diffuse Modes (model suffix DB & W)



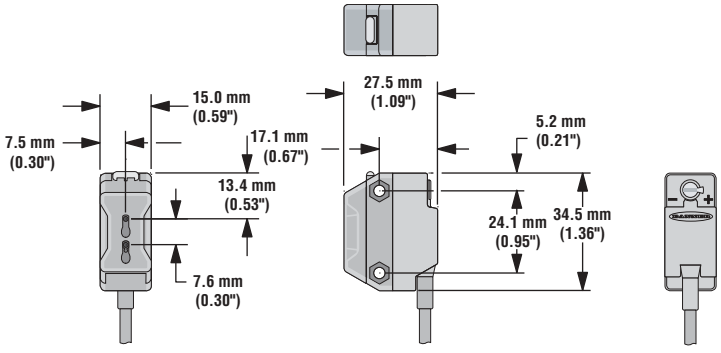
Adjustable Field Mode (model suffix AF)



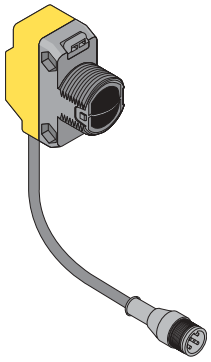
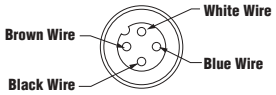
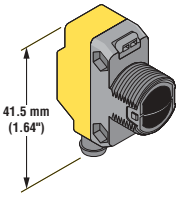
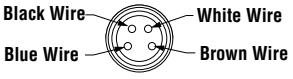
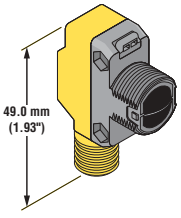
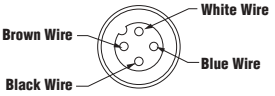
Features



Plastic Fiber Optic Mode (model suffix FP)



Modifications

Model Suffix	Modification	Description	Example of Model Number	Used With:
Q5	4-Pin Euro Pigtail QD	 **4-pin Euro-style Pin-out** 	**QS18VN6RQ5**	All QS18 models except AF100 models
Q7	4-Pin Pico Integral	 **4-pin Pico-style Pin-out** 	**QS18VN6RQ7**	All QS18 models except AF100 models
Q8	4-Pin Euro Integral	 **4-pin Euro-style Pin-out** 	**QS18VN6RQ8**	All QS18 models except AF100 models

Quick-Disconnect (QD) Cables

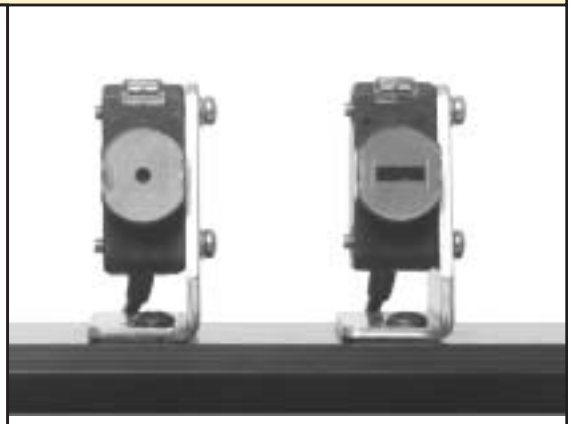
Following is the selection of cables available for WORLD-BEAM QD models. See the Accessories section at back of catalog for more cable information.

Style	Model	Length	Connector	Used with:
4-Pin Pico	**PKG4-2** **PKW4-2**	2 m (6.5') 2 m (6.5')	Straight Right-Angle	WORLD-BEAM with Q or Q7 suffix
4-Pin Euro	**MQDC-406** **MQDC-415** **MQDC-430** **MQDC-406RA** **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30') 2 m (6.5') 5 m (15') 9 m (30')	Straight Straight Straight Right-Angle Right-Angle Right-Angle	WORLD-BEAM with Q5 or Q8 suffix

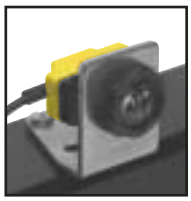
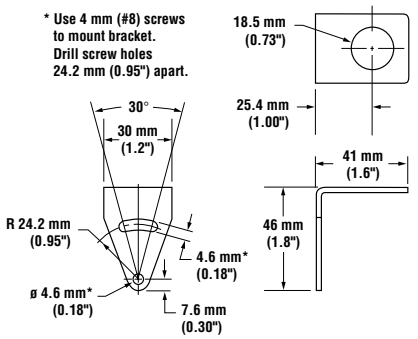
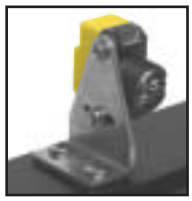
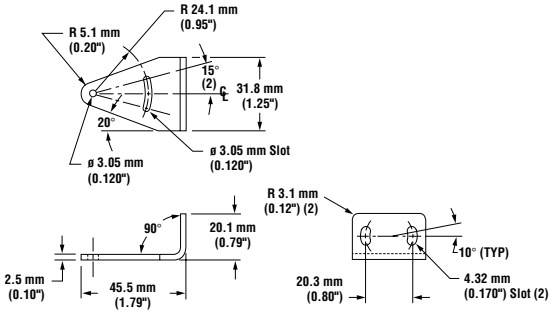
Apertures

WORLD-BEAM opposed mode sensors may be fitted with stainless steel apertures which narrow or shape the effective beam of the sensor to more closely match the size or profile of the object to be sensed. This will reduce the sensing range of the particular sensors. A common example is the use of “line” or “slit” type aperture when wire or thread is be sensed. Each model contains 6 apertures.

Model	Description
APQS18-020	0.5 mm (0.02") diameter, circular
APQS18-040	1.0 mm (0.04") diameter, circular
APQS18-100	2.5 mm (0.10") diameter, circular
APQS18-020H	0.5 x 6.4 mm (0.02 x 0.25"), horizontal slotted
APQS18-040H	1.0 x 6.4 mm (0.04 x 0.25"), horizontal slotted
APQS18-100H	2.5 x 6.4 mm (0.10 x 0.25"), horizontal slotted
APQS18-020V	0.5 x 12.7 mm (0.02 x 0.50"), vertical slotted
APQS18-040V	1.0 x 12.7 mm (0.04 x 0.50"), vertical slotted
APQS18-100V	2.5 x 12.7 mm (0.10 x 0.50"), vertical slotted
APQS18-DVHX2	Kit containing two of each aperture



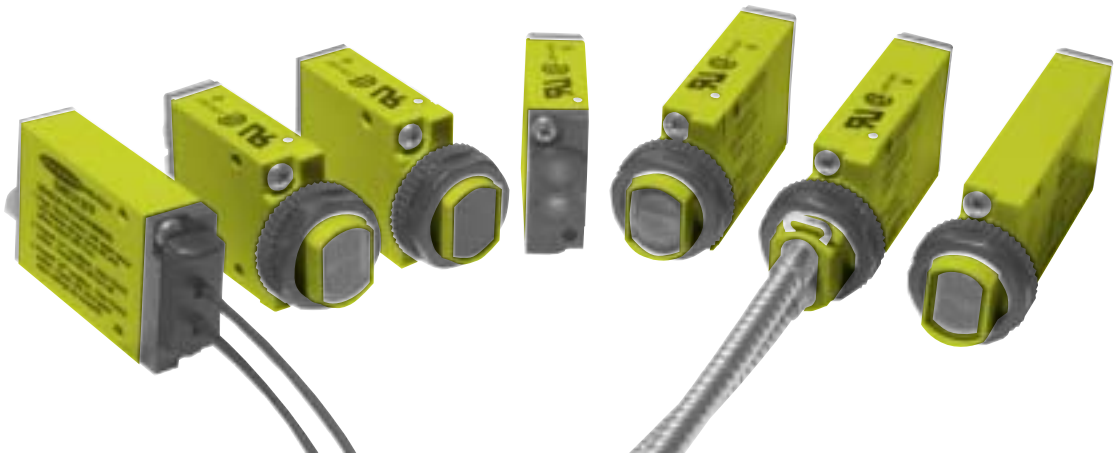
Mounting Brackets

Model	Description	Dimensions
SMB18A 	• 12-gauge, stainless steel • Right-angle mounting bracket • Used with QS18 models with 18 mm threaded nose	
SMB312S 	• Stainless steel 2-axis, side mounting bracket • Used with all QS18 models except for QS18 Adjustable Field	

Retroreflective Targets

Banner offers a wide selection of high-quality retroreflective targets. See Accessories section for complete information.

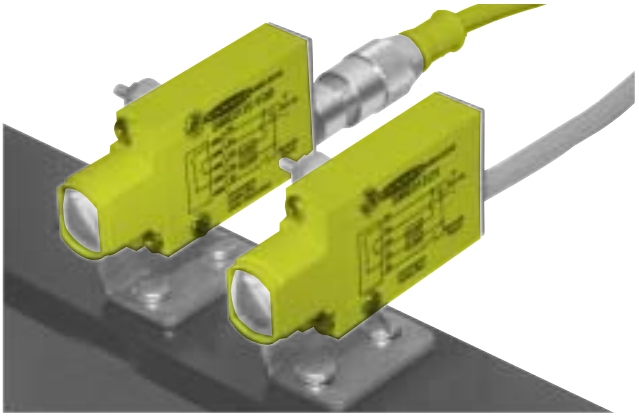
NOTES:



MINI-BEAM® Sensors

MINI-BEAM sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

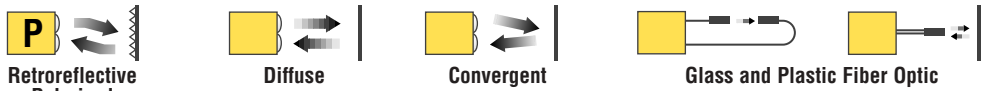
MINI-BEAM *Expert*™ Sensors

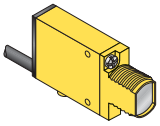


* U.S. Patent no. 5808296

- TEACH-mode sensors in the popular MINI-BEAM package
- Easy push-button programming automatically adjusts sensitivity to optimal setting*
- Fast, 500 microsecond (0.5 millisecond) output response
- Bipolar NPN (sinking) / PNP (sourcing) outputs
- Easy output programming eliminates the need for Light or Dark Operate selection
- Separate TEACH input allows remote programming by an external device, such as a switch or a process controller
- Green Stability indicator flashes when received signal level approaches the switching threshold, also indicates Power ON
- Choose models with integral 2 m (6.5') cable or 5-pin Euro-style quick-disconnect (QD) connector; 9 m (30') cables are also available

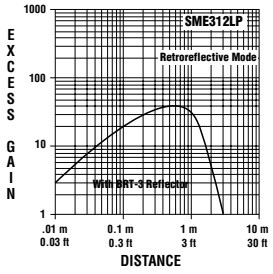
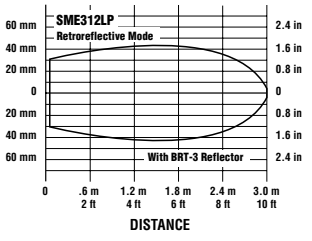
MINI-BEAM *Expert* Sensing Mode Options





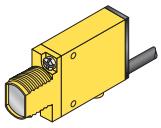
Polarized, Visible red, 650 nm

MINI-BEAM *Expert* Series Polarized Retroreflective Mode

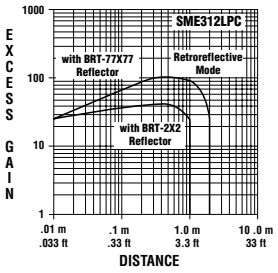
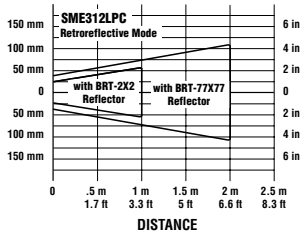
Models	Range*	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Polarized						
SME312LP **SME312LPQD**	10 mm to 3 m (0.4" to 10')	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) used. See Accessories section for more information.

Visible red, 650 nm

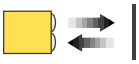


MINI-BEAM *Expert* Series Polarized Retroreflective Clear Object Detection

Models	Range*	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SME312LPC **SME312LPCQD**	1 m (3.3') with supplied reflector	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		

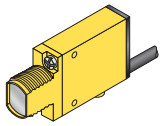
*NOTE: Sensing range will vary, according to the efficiency and reflective area of the retroreflector(s) used. For these low-contrast applications, the model BRT-2X2 (2" x 2") reflector is recommended, and one is bundled with each SME312LPC(QD) sensor.

- For applications that involve high levels of vibration, the model BRT-36x40BM, with its micro-prism geometry, is recommended.
- For long-range applications, the BRT-77X77C reflector provides a range up to 2 m (6.5').
- SME312LPC(QD) are for use with corner cube type reflectors only; reflective tape is not recommended. See the Accessories section for more information.

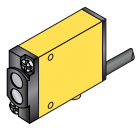


Infrared, 880 nm

†Note: Divergent diffuse models recommended for sensing clear materials.

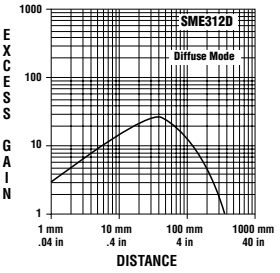
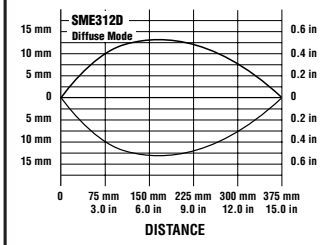
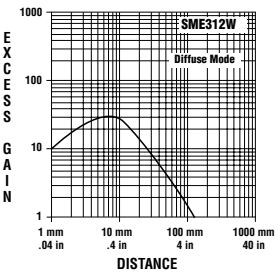
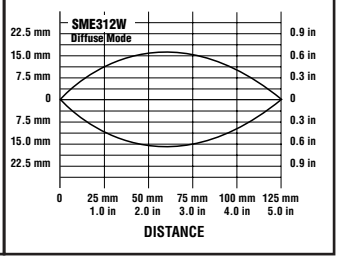


D Models

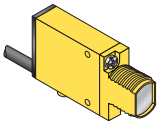


W Models

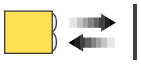
MINI-BEAM *Expert* Series Diffuse Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SME312D **SME312DQD**	380 mm (15")	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
Divergent Diffuse†						
SME312W **SME312WQD**	130 mm (5")	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		

NOTES: i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g., **SME312D W/30**)
ii) A model with a QD connector requires a mating cable. See page 152 and the Accessories section for more information.

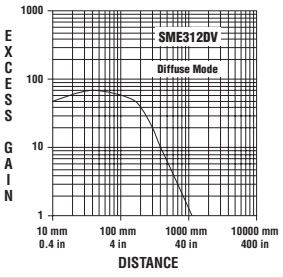
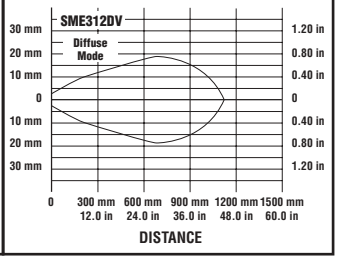


The SME312DV sensors are effective for sensing specular surfaces such as semi-conductor wafers, disk drive media, glass and machined surfaces. The collimated optics of the SME312DV also permits the sensor to be mounted against clear container walls, view ports and other types of optical “feed-throughs.”

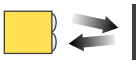


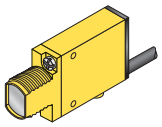
Visible red, 650 nm

MINI-BEAM *Expert* Series Diffuse Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SME312DV **SME312DVQD**	1100 mm (43")	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		

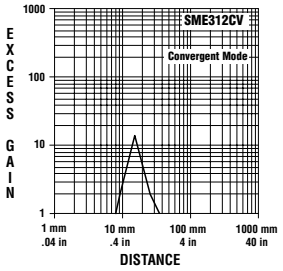
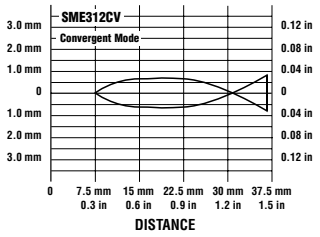
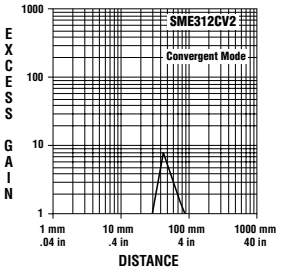
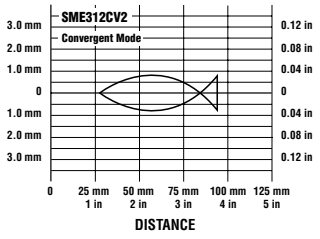
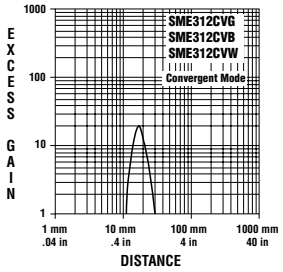
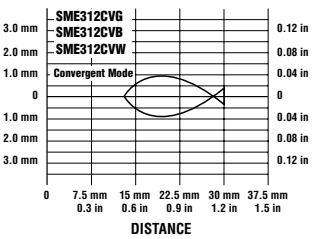
NOTES: i) 9 m (30') cables are available by adding suffix **“W/30”** to the model number of any cabled sensor (e.g., **SME312DV W/30**)
ii) A model with a QD connector requires a mating cable. See page 152 and the Accessories section for more information.



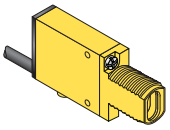


See Sensing Beam Information Below

MINI-BEAM *Expert* Series Convergent Mode

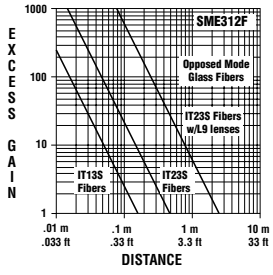
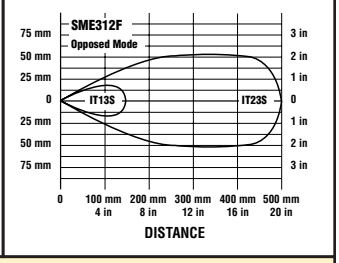
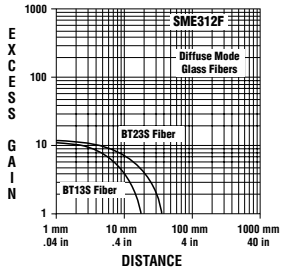
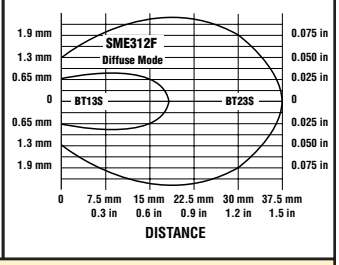
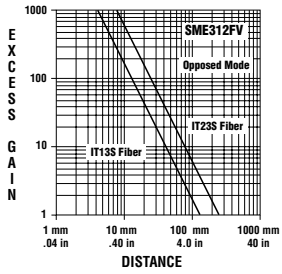
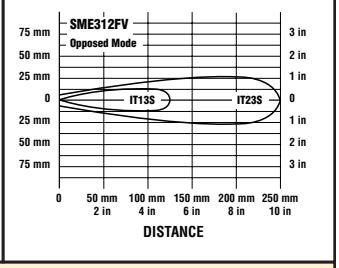
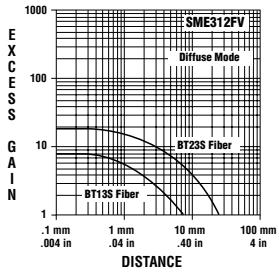
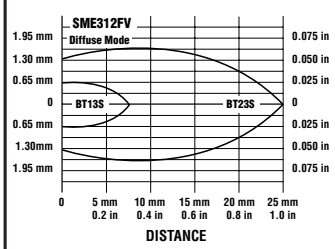
Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Visible Red 650 nm						
SME312CV **SME312CVQD**	16 mm (0.65") **Spot Size at Focus:** 1.3 mm (0.05")	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
SME312CV2 **SME312CV2QD**	43 mm (1.7") **Spot Size at Focus:** 3.0 mm (0.12")	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
Visible Green 525 nm*						
SME312CVG **SME312CVGQD**	16 mm (0.65") **Spot Size at Focus:** 1.0 mm (0.04")	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
Visible Blue 475 nm*						
SME312CVB **SME312CVBQD**	16 mm (0.65") **Spot Size at Focus:** 1.8 mm (0.07")	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
Visible White 450-650 nm*						
SME312CVW **SME312CVWQD**	16 mm (0.65") **Spot Size at Focus:** 1.8 mm (0.07")	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		

*Note: Green, blue, and white LED models are recommended for color mark sensing applications. Consult your local or factory sales engineer for model selection assistance.



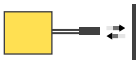
See Sensing Beam Information Below

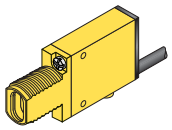
MINI-BEAM *Expert* Series Glass Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Infrared 880 nm					OPPOSED MODE – INDIVIDUAL FIBERS	
SME312F **SME312FQD**	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
					DIFFUSE MODE – BIFURCATED FIBERS	
						
Visible Red 650 nm					OPPOSED MODE – INDIVIDUAL FIBERS	
SME312FV **SME312FVQD**	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
					DIFFUSE MODE – BIFURCATED FIBERS	
						

NOTES: i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g., **SME312F W/30**)

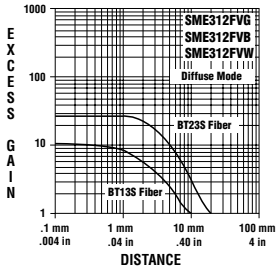
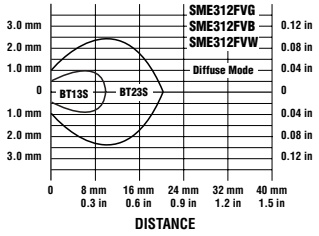
ii) A model with a QD connector requires a mating cable. See page 152 and the Accessories section for more information.



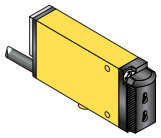


See Sensing Beam Information Below

MINI-BEAM *Expert* Series Glass Fiber Optic

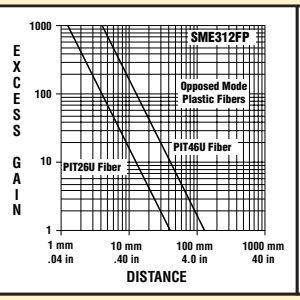
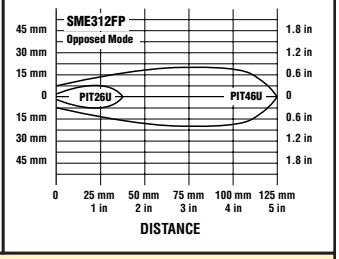
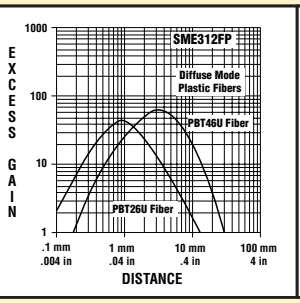
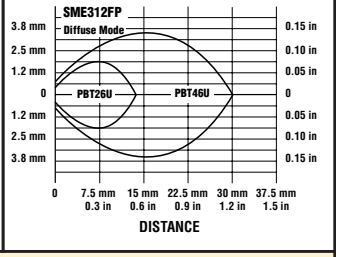
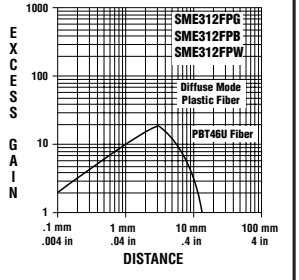
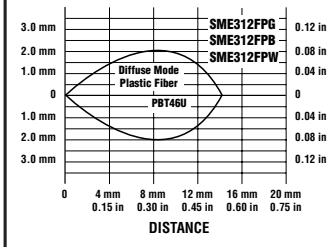
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Visible Green 525 nm					DIFFUSE MODE – BIFURCATED FIBERS	
SME312FVG **SME312FVGQD**	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
Visible Blue 475 nm						
SME312FVB **SME312FVBQD**	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
Visible White 450-650 nm						
SME312FVW **SME312FVWQD**	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		

Note: Green, blue, and white LED models are recommended for color mark sensing applications. Consult your local or factory sales engineer for model selection assistance.



See Sensing Beam Information Below

MINI-BEAM *Expert* Series Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Visible Red 650 nm					OPPOSED MODE – INDIVIDUAL FIBERS	
SME312FP **SME312FPQD**	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
					DIFFUSE MODE – BIFURCATED FIBERS	
						
Visible Green 525 nm					DIFFUSE MODE – BIFURCATED FIBERS	
SME312FPG **SME312FPGQD**	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
Visible Blue 475 nm						
SME312FPB **SME312FPBQD**	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		
Visible White 450-650 nm						
SME312FPW **SME312FPWQD**	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5') 5-Pin Euro-style QD	10-30V dc	Bipolar NPN/PNP		

NOTES: i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g., **SME312FPB W/30**)

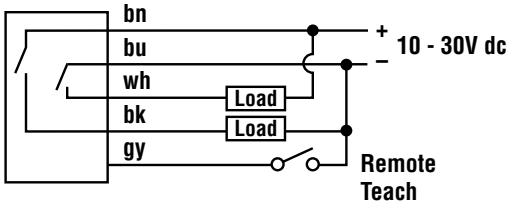
ii) A model with a QD connector requires a mating cable. See page 152 and the Accessories section for more information.

MINI-BEAM *Expert* Series Specifications

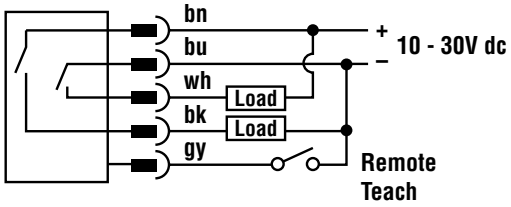
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 45 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	150mA maximum each output at 25°C, derated to 100 mA at 70°C (derate ≈1 mA per °C) **Off-state leakage current:** less than 5µA @ 30V dc **Output saturation voltage** (PNP output) less than 1 volt at 10 mA and less than 2 volts at 150 mA **Output saturation voltage** (NPN output) less than 200 millivolts at 10 mA and less than 1 volt at 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Output Response Time	Sensors will respond to either a "light" or a "dark" signal of 500 micro seconds or longer duration, 1 kHz max. NOTE: 1 second delay on power-up; outputs are non-conducting during this time.
Repeatability	100 microseconds (all models)
Adjustments	Push-button TEACH mode sensitivity setting; remote TEACH mode input is provided (gray wire)
Indicators	Two LEDs: Yellow and Bi-color Green/Red **Green (RUN Mode):** ON when power is applied Flashes when received light level approaches the switching threshold **Red (TEACH Mode):** OFF when no signal is received. Pulses to indicate signal strength (received light level). Rate is proportional to signal strength (the stronger the signal, the faster the pulse rate). This is a function of Banner's patented Alignment Indicating Device (AID™, US patent 4356393). **Yellow (TEACH Mode):** ON to indicate sensor is ready to learn output ON condition OFF to indicate sensor is ready to learn output OFF condition **Yellow (RUN Mode):** ON when outputs are conducting
Construction	Reinforced thermoplastic polyester housing, totally encapsulated, o-ring seal, acrylic lenses, and stainless steel screws.
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 12, and 13; IEC IP67
Connections	PVC-jacketed 5-conductor 2 m (6.5') or 9 m (30') unterminated cable, or 5-pin Euro-style quick-disconnect (QD) fitting are available. QD cables are ordered separately; see page 152.
Operating Conditions	**Temperature:** -20° to +70°C (-4° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	The first condition presented during TEACH mode becomes the output ON condition.
Certifications	CE c UL® US

MINI-BEAM *Expert* Hookup Diagrams

MINI-BEAM Expert Series Sensor (Cabled models)



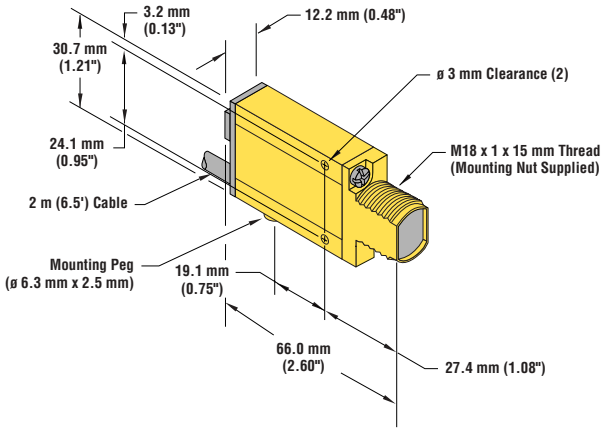
MINI-BEAM Expert Series Sensor (Quick-disconnect models)



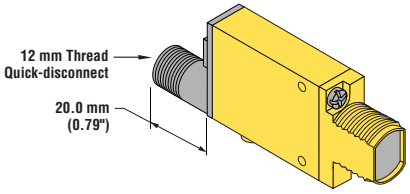
MINI-BEAM *Expert* Dimensions

MINI-BEAM *Expert* Series Sensor
(models with suffix LP, LPC, D, DV, CV, CV2, CVG, CVB and CVW)

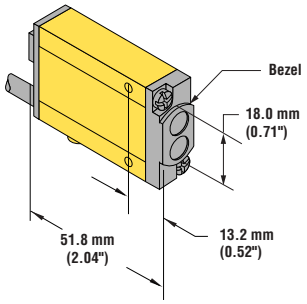
Cabled Models



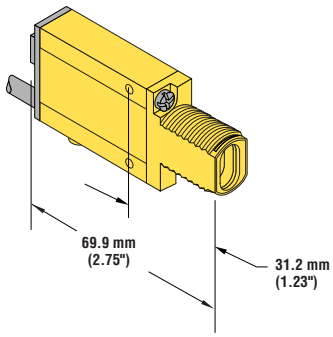
Quick-Disconnect Models



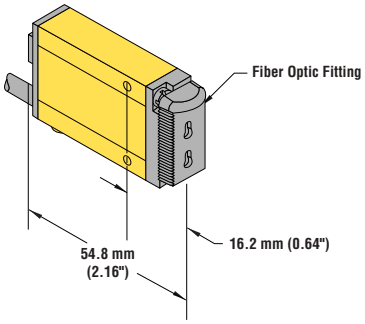
MINI-BEAM *Expert* Series Sensor
Divergent Diffuse Mode
(models with suffix W)



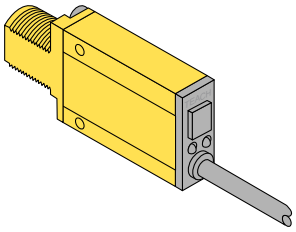
MINI-BEAM *Expert* Series Sensor
Glass Fiber Optic
(models with suffix F, FV, FVG, FVB and FVW)



MINI-BEAM *Expert* Series Sensor
Plastic Fiber Optic
(models with suffix FP, FPG, FPB and FPW)



MINI-BEAM *Expert* Sensor - Rear View

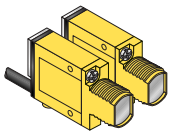


MINI-BEAM Sensors

MINI-BEAM Glass Fiber Optic sensors (left) and MINI-BEAM with visible blue LED sensors (right) shown

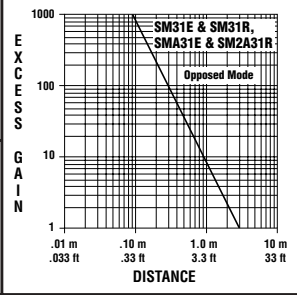
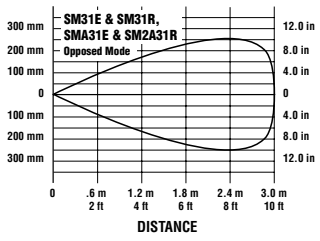
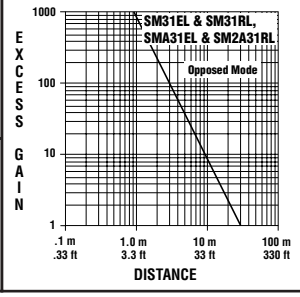
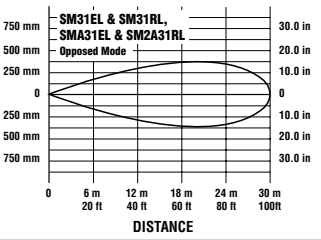
- Select 4-wire dc or simple 2-wire ac models
- DC models have bipolar outputs (one NPN and one PNP)
- Rear-panel light/dark operate switch
- DC models include patented Alignment Indicating Device (AID™) signal strength monitoring indicator
- 475 nm visible blue and 525 nm green light sensors provide an economical solution to a large percentage of mainstream color mark applications; they reliably sense many difficult color combinations, including yellow-against-white and pink-against-white
- 2 m (6.5') is standard integral cable length; 9 m (30') is also available
- Integral quick-disconnect (QD) fitting is standard; 150 mm (6 in) pigtail QD is also available
- DC models may be ordered with 0.3 millisecond response (use model suffix "MHS")

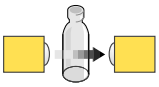
MINI-BEAM Sensing Mode Options



Infrared, 880 nm

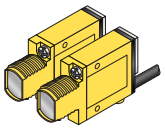
MINI-BEAM Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SM31E **SM31R** **SM31EQD** **SM31RQD**	3 m (10')	2 m (6.5') 2 m (6.5') 4-Pin Euro QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		Effective Beam: 3.5 mm 
SMA31E **SM2A31R** **SMA31EQD** **SM2A31RQD**		2 m (6.5') 2 m (6.5') 3-Pin Micro QD 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
SM31EL **SM31RL** **SM31ELQD** **SM31RLQD**	30 m (100')	2 m (6.5') 2 m (6.5') 4-Pin Euro QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		Effective Beam: 13 mm 
SMA31EL **SM2A31RL** **SMA31ELQD** **SM2A31RLQD**		2 m (6.5') 2 m (6.5') 3-Pin Micro QD 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		



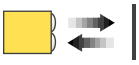
Visible red, 650 nm

- Unique optical arrangement actively detects clear plastic in the beam
- Clear plastic is reliably detected and differentiated from all other material
- Commonly used for manufacture or processing of clear plastic bottles or webs
- All MINI-BEAM Clear Plastic Detection System sensors include a mounting bracket

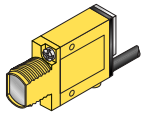


MINI-BEAM Opposed Mode Clear Plastic Detection System

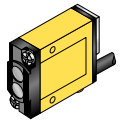
Models	Range	Cable	Supply Voltage	Output Type	Application Information
SM31EPD **SM31RPD** **SM31EPDQD** **SM31RPDQD**	0 - 0.3 m (0 - 1')	2 m (6.5') 2 m (6.5') 4-Pin Euro QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP	Actual Range is dependent upon the light transmission properties of the plastic material being sensed. Some clear plastic materials may not be detected due to their molecular structure. When in doubt, ask your salesperson to evaluate material samples.
SMA31EPD **SM2A31RPD** **SMA31EPDQD** **SM2A31RPDQD**		2 m (6.5') 2 m (6.5') 3-Pin Micro QD 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire	



Infrared, 880 nm

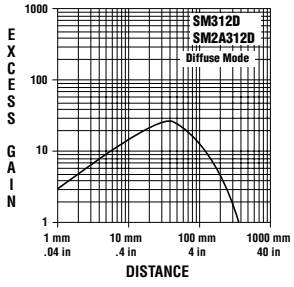
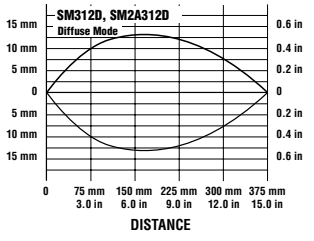
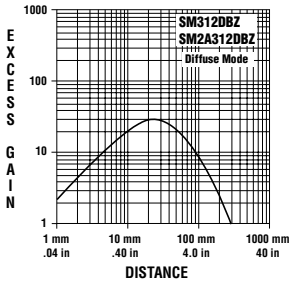
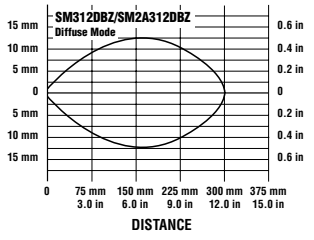
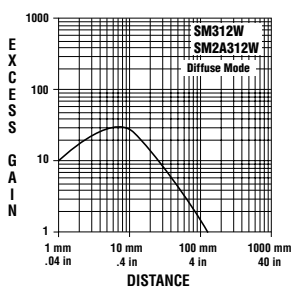
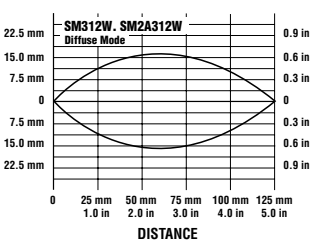


D Models

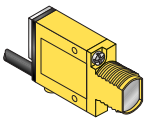


DBZ and W Models

MINI-BEAM Diffuse Mode

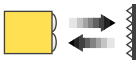
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SM312D **SM312DQD**	380 mm (15")	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312D **SM2A312DQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
SM312DBZ **SM312DBZQD**	300 mm (12")	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312DBZ **SM2A312DBZQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
Divergent Diffuse*						
SM312W **SM312WQD**	130 mm (5")	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312W **SM2A312WQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPDT Solid-state 2-Wire		

*Note: Recommended for sensing clear materials.



Non-Polarized, Polarized

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3-inch diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

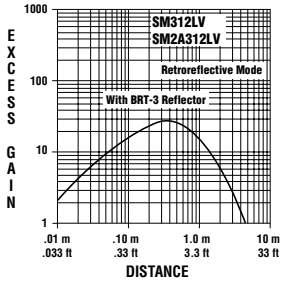
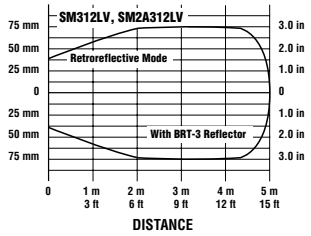
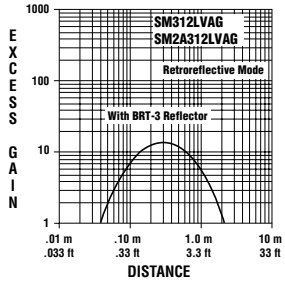
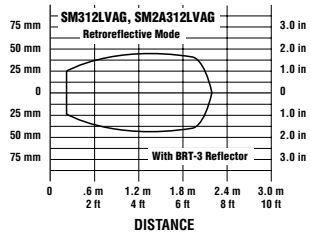
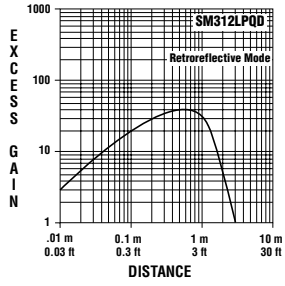
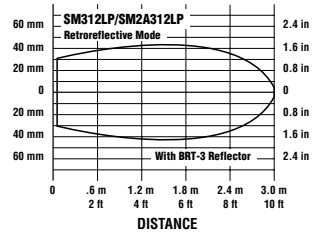


Non-Polarized

Visible red, 650 nm

Polarized

MINI-BEAM Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
SM312LV **SM312LVQD**	5 m (15')	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312LV **SM2A312LVQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
Polarized*						
SM312LVAG **SM312LVAGQD**	50 mm to 2 m (2" to 7')	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312LVAG **SM2A312LVAGQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
Polarized Extended Range						
SM312LP **SM312LPQD**	10 mm to 3 m (0.4" to 10')	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312LP **SM2A312LPQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		

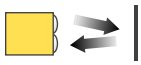
*Use polarized models when shiny objects will be sensed.

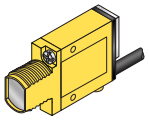
For Standard MINI-BEAMs:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SM312LV W/30**)

ii) A 150 mm (6") long pigtail cable with attached QD connector is available by adding suffix **"QDP"** to the model number of any MINI-BEAM sensor (e.g. - **SM312LVQDP**). See page 152 for more information.

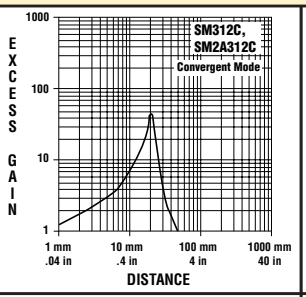
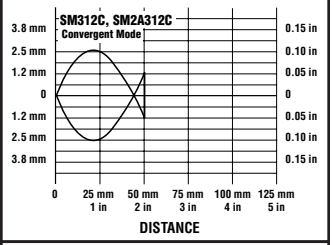
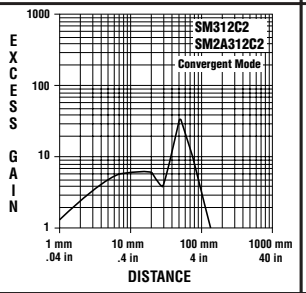
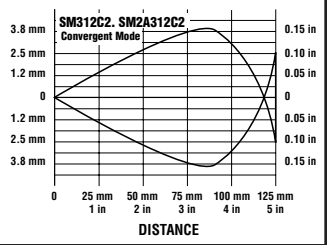
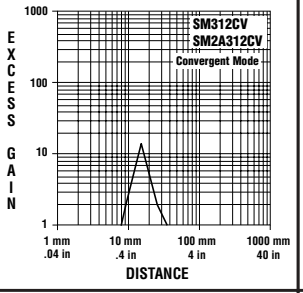
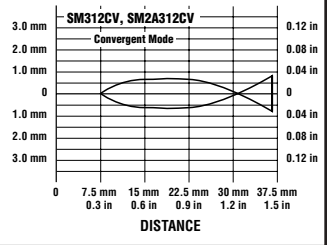
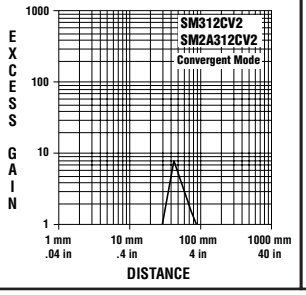
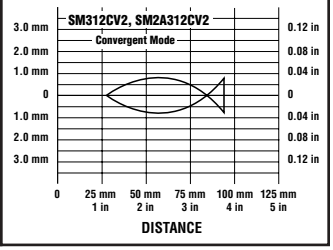
iii) A model with a QD connector requires an accessory mating cable. See pages 152 and the Accessories section for more information.

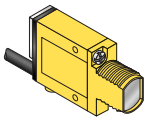




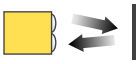
See Sensing Beam Information Below

MINI-BEAM Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Infrared 880 nm						
SM312C **SM312CQD**	16 mm (0.65")	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312C **SM2A312CQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
SM312C2 **SM312C2QD**	43 mm (1.7")	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312C2 **SM2A312C2QD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
Visible Red 650 nm						
SM312CV **SM312CVQD**	16 mm (0.65") Spot Size at Focus: 1.3 mm (0.05")	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312CV **SM2A312CVQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
SM312CV2 **SM312CV2QD**	43 mm (1.7") Spot Size at Focus: 3.0 mm (0.12")	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312CV2 **SM2A312CV2QD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		

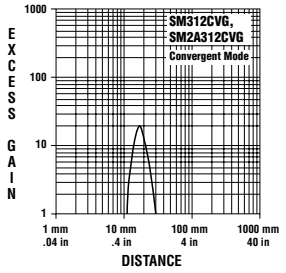
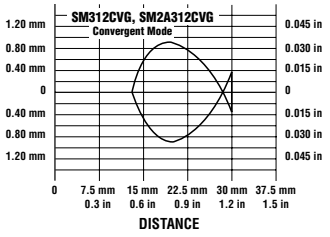
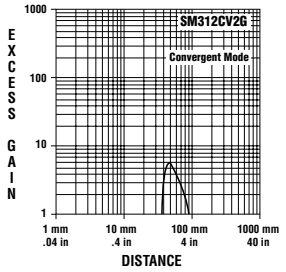
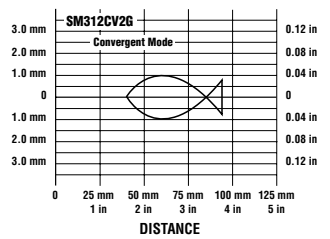
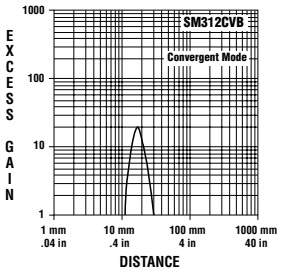
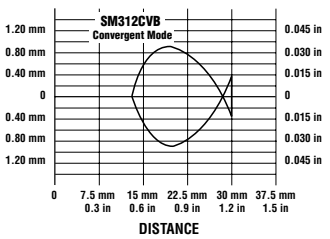
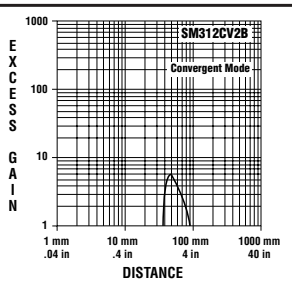
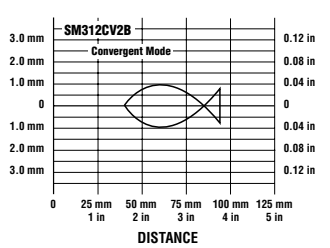


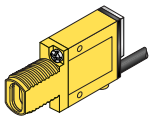
Green and blue LED models are recommended for color mark sensing applications.
Consult your local or factory sales engineer for model selection assistance.



See Sensing Beam Information Below

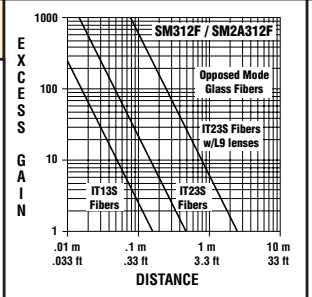
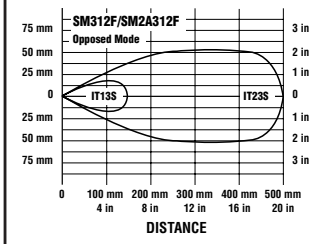
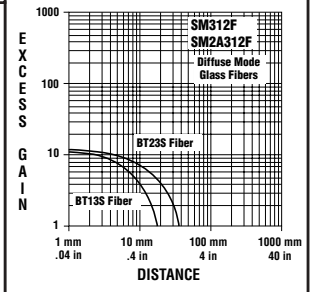
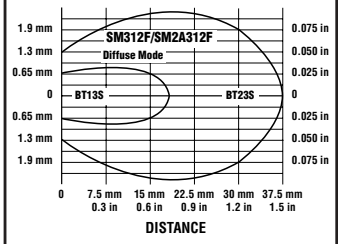
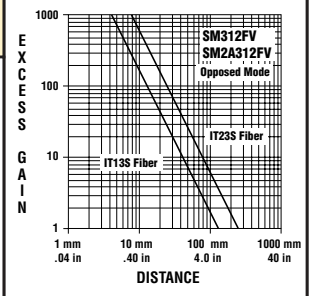
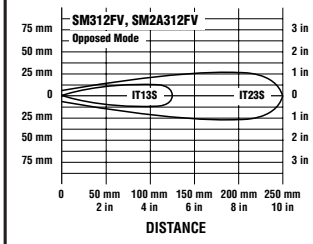
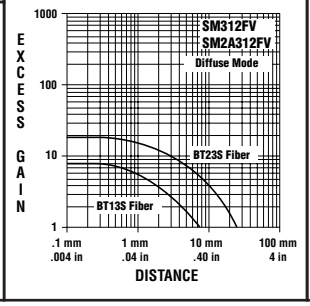
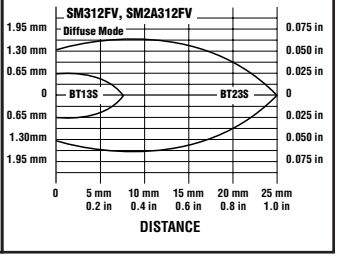
MINI-BEAM Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Visible Green 525 nm						
SM312CVG **SM312CVGQD**	16 mm (0.65") Spot Size at Focus: 1.0 mm (0.04")	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312CVG **SM2A312CVGQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
SM312CV2G **SM312CV2GQD**	49 mm (1.9".)	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Visible Blue 475 nm						
SM312CVB **SM312CVBQD**	16 mm (0.65") Spot Size at Focus: 1.8 mm (0.07")	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM312CV2B **SM312CV2BQD**	49 mm (1.9".)	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		



See Sensing Beam Information Below

MINI-BEAM Glass Fiber Optic

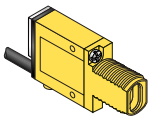
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Infrared 880 nm						
SM312F **SM312FQD**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312F **SM2A312FQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		
Visible Red 650 nm						
SM312FV **SM312FVQD**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312FV **SM2A312FVQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		

For Standard MINI-BEAMs:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SM312FV W/30**)

ii) A 150 mm (6") long pigtail cable with attached QD connector is available by adding suffix **"QDP"** to the model number of any MINI-BEAM sensor (e.g. - **SM312FVQDP**). See page 152 for more information.

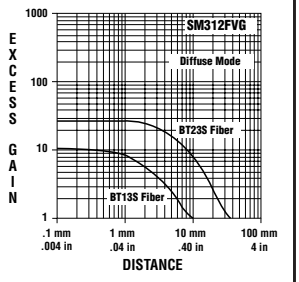
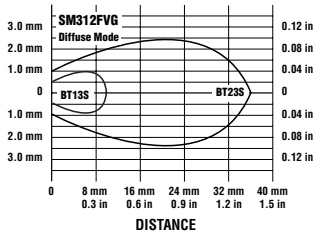
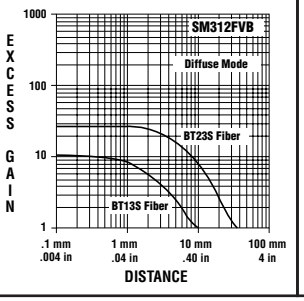
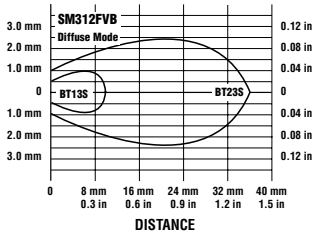
iii) A model with a QD connector requires an accessory mating cable. See pages 152 and the Accessories section for more information

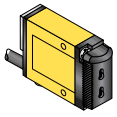


Green and blue LED models are recommended for color mark sensing applications.
Consult your local or factory sales engineer for model selection assistance.

See Sensing Beam Information Below

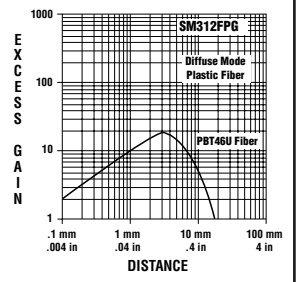
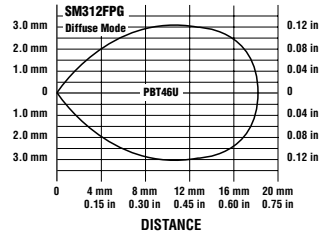
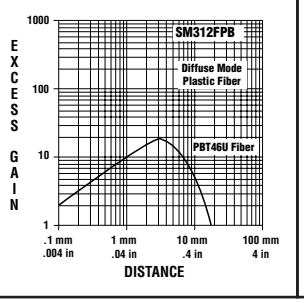
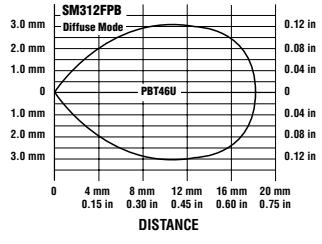
MINI-BEAM Glass Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Visible Green 525 nm						
SM312FVG **SM312FVGQD**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Visible Blue 475 nm						
SM312FVB **SM312FVBQD**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		

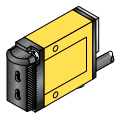


See Sensing Beam Information Below

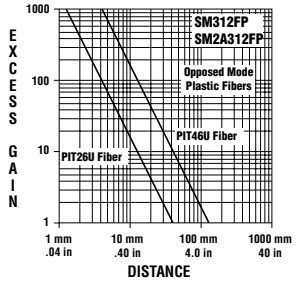
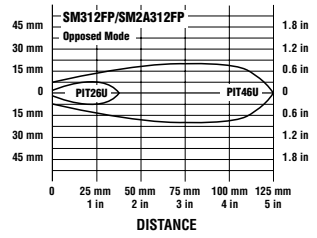
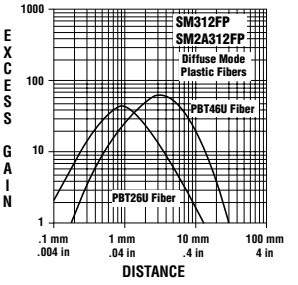
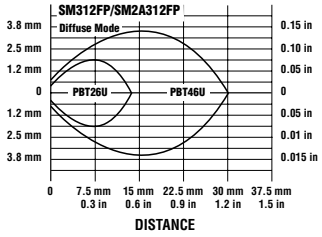
MINI-BEAM Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Visible Green 525 nm						
SM312FPG **SM312FPGQD**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Visible Blue 475 nm						
SM312FPB **SM312FPBQD**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		

Visible red, 650 nm



MINI-BEAM Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
SM312FP **SM312FPQD**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
SM2A312FP **SM2A312FPQD**		2 m (6.5') 3-Pin Micro QD	24-240V ac	SPST Solid-state 2-Wire		

For Standard MINI-BEAMs:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SM312FP W/30**)

ii) A 150 mm (6") long pigtail cable with attached QD connector is available by adding suffix **"QDP"** to the model number of any MINI-BEAM sensor (e.g. - **SM312FPQDP**). See page 152 for more information.

iii) A model with a QD connector requires an accessory mating cable. See pages 152 and the Accessories section for more information.

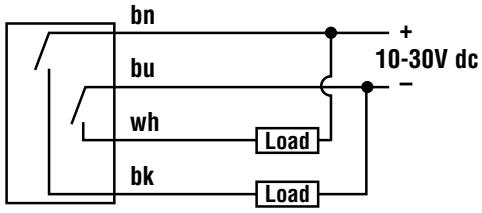
MINI-BEAM DC Specifications

Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 25 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	150mA maximum each output at 25°C, derated to 100 mA at 70°C (derate ≈1 mA per °C) **Off-state leakage current** less than 1 microamp **Output saturation voltage** (PNP output) less than 1 volt at 10 mA and less than 2 volts at 150 mA **Output saturation voltage** (NPN output) less than 200 millivolts at 10 mA and less than 1 volt at 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Output Response Time	Sensors will respond to either a "light" or a "dark" signal of 1 millisecond or longer duration, 500 Hz max. 0.3 millisecond response modification is available. See note below. (NOTE: 100 millisecond delay on power-up: outputs are non-conducting during this time.)
Repeatability	**Opposed:** 0.14 milliseconds; **Non-Polarized and Polarized Retro, Diffuse, Convergent, Glass and Plastic Fiber Optic:** 0.3 milliseconds. Response time and repeatability specifications are independent of signal strength.
Adjustments	LIGHT/DARK OPERATE select switch, and 15-turn slotted brass screw GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel). Both controls are located on rear panel of sensor and protected by a gasketed, clear acrylic cover.
Indicators	Exclusive, patented Alignment Indicating Device system (AID™, US patent #4356393) lights a rear-panel mounted red LED indicator whenever the sensor sees a "light" condition, with a superimposed pulse rate proportional to the light signal strength (the stronger the signal, the faster the pulse rate).
Construction	Reinforced thermoplastic polyester housing, totally encapsulated, o-ring sealing, acrylic lenses, and stainless steel screws.
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 12, and 13; IEC IP67
Connections	PVC-jacketed 4-conductor 2 m (6.5') or 9 m (30') cables, or 4-pin euro-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 152 and Accessories section.
Operating Conditions	**Temperature:** -20° to +70°C (-4° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	The NPN (current sinking) output of dc MINI-BEAM sensors is directly compatible as an input to Banner logic modules, including all non-amplified MAXI-AMP and MICRO-AMP modules. MINI-BEAMs are TTL compatible.
Certifications	

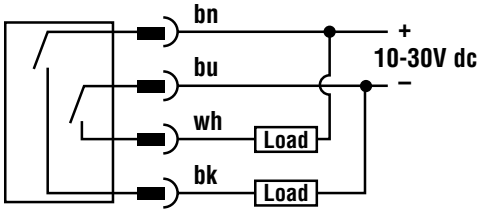
Note: DC MINI-BEAMs may be ordered with 0.3 millisecond on/off response by adding suffix **"MHS"** to the model number (e.g. - **SM312LVMHS**). This modification reduces sensing range (and excess gain).

MINI-BEAM DC Hookup Diagrams

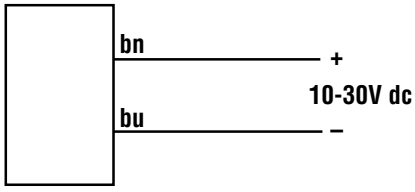
DC Sensors with Attached Cable



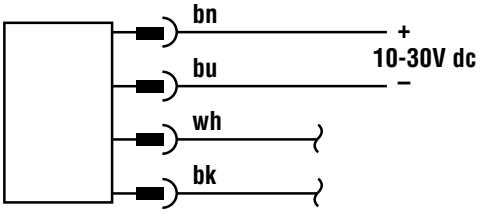
DC Sensors with Quick-Disconnect (4-Pin Euro-Style)



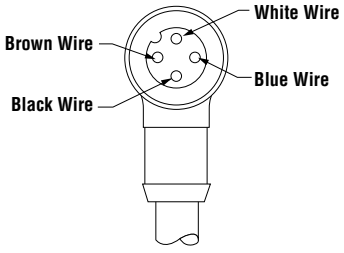
DC Emitters with Attached Cable



DC Emitters with Quick-Disconnect (4-Pin Euro-Style)



4-Pin Euro-Style Pin-out (Cable Connector Shown)



Quick-Disconnect (QD) Option

DC MINI-BEAM sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 4-pin euro-style QD cable fitting.

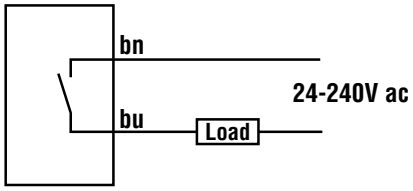
DC QD sensors are identified by the letters “QD” in their model number suffix. Mating cables for QD MINI-BEAM sensors are model MQDC-415 (straight connector) or MQDC-415RA (right-angled connector). Cables are supplied in a standard length of 5 m (15'). For more information on QD cables, see page 152 and the Accessories section.

MINI-BEAM AC Specifications

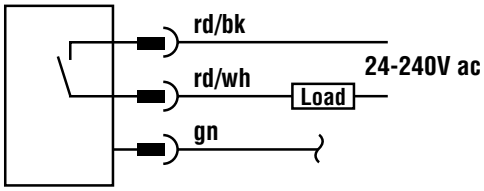
Supply Voltage and Current	24 to 240V ac (50/60 Hz), 250V ac max
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	SPST SCR solid-state relay with either normally closed or normally open contact (light/dark operate selectable); 2-wire hookup
Output Rating	Minimum load current 5 mA; maximum steady-state load capability 300 mA to 50°C ambient (122°F) 100 mA to 70°C ambient (158°F) **Inrush capability** 3 amps for 1 second (non repetitive); 10 amps for 1 cycle (non repetitive) **Off-state leakage current** less than 1.7 mA rms **On-state voltage** drop ≤5 volts at 300 mA load, ≤10 volts at 15 mA load
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	**Opposed Mode:** 2 millisecond on and 1 millisecond off; **Non-Polarized and Polarized Retro, Convergent, Plastic Fiber Optic:** 4 milliseconds on and off; **Diffuse and Glass Fiber Optic:** 8 milliseconds on and off "OFF" response time specification does not include load response of up to ½ ac cycle (8.3 milliseconds). Response time specification of load should be considered when important. (NOTE: 300 millisecond delay on power-up.)
Repeatability	**Opposed:** 0.3 milliseconds; **Non-Polarized and Polarized Retro, and Convergent and Plastic Fiber Optic:** 1.3 milliseconds; **Diffuse and Glass Fiber Optics:** 2.6 milliseconds Response time and repeatability specifications are independent of signal strength.
Adjustments	LIGHT/DARK OPERATE select switch, and 15-turn slotted brass screw GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel). Both controls are located on rear panel of sensor and protected by a gasketed, clear acrylic cover.
Indicators	Red indicator LED on rear of sensor is "ON" when the load is energized
Construction	Reinforced thermoplastic polyester housing, totally encapsulated, o-ring sealing, acrylic lenses, and stainless steel screws
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 12, and 13; IEC IP67
Connections	PVC-jacketed 2-conductor 2 m (6.5ft) or 9 m (30ft) cables, or 3-pin micro-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 152 and Accessories section.
Operating Conditions	**Temperature:** -20° to +70°C (-4° to +158°F) **Maximum Relative Humidity:** 90% at 50°C (non-condensing)
Application Notes	i) ac MINI-BEAMs may be destroyed from overload conditions ii) Use on low voltage requires careful analysis of the load to determine if the leakage current or on-state voltage of the sensor will interfere with proper operation of the load iii) The false-pulse protection feature may cause momentary drop-out of the load when the sensor is wired in series or parallel with mechanical switch contacts
Certifications	

MINI-BEAM AC Hookup Diagrams

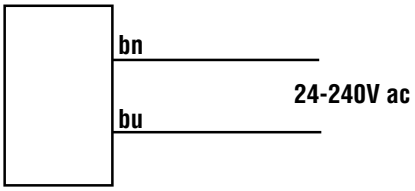
AC Sensors with Attached Cable



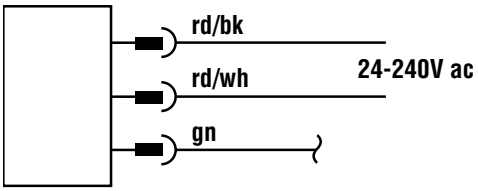
AC Sensors with Quick-Disconnect (3-Pin Micro-Style)



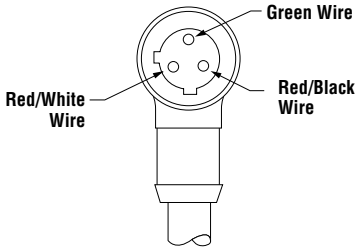
AC Emitters with Attached Cable



AC Emitters with Quick-Disconnect (3-Pin Micro-Style)



3-Pin Micro-Style Pin-out (Cable Connector Shown)



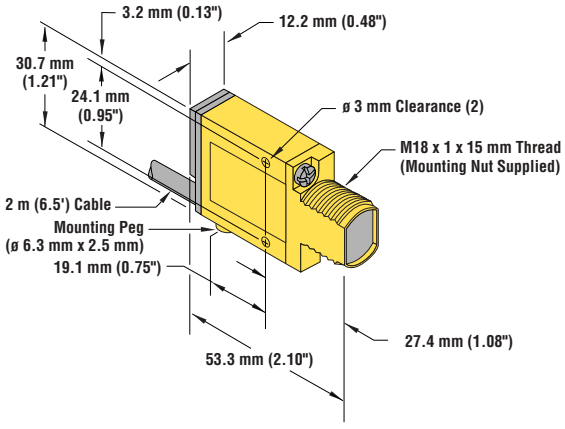
Quick-Disconnect (QD) Option

AC MINI-BEAM sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 3-pin micro-style QD cable fitting.

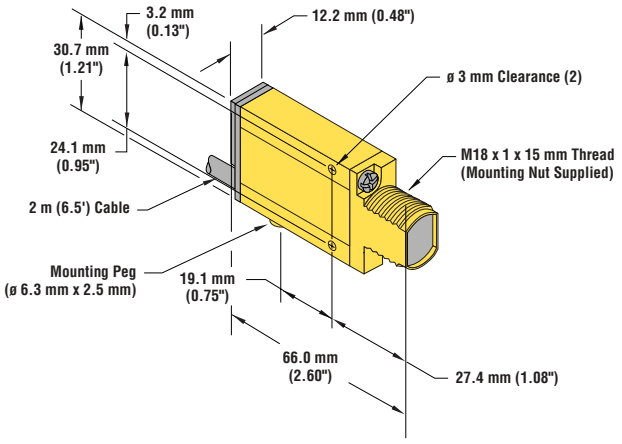
AC QD sensors are identified by the letters “QD” in their model number suffix. Mating cables for QD MINI-BEAM sensors are model MQDC-315 (straight connector) or MQDC-315RA (right-angled connector). Cables are supplied in a standard length of 5 m (15'). For more information on QD cables, see page 152 and the Accessories section.

MINI-BEAM Dimensions

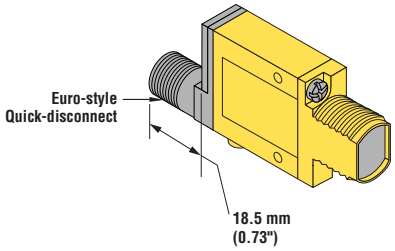
MINI-BEAM DC Sensor



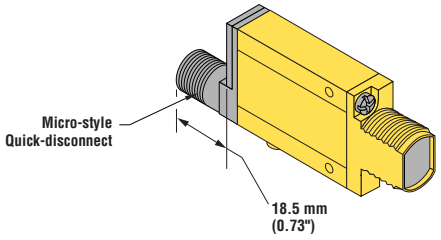
MINI-BEAM AC Sensor



MINI-BEAM DC Sensor with Quick-Disconnect

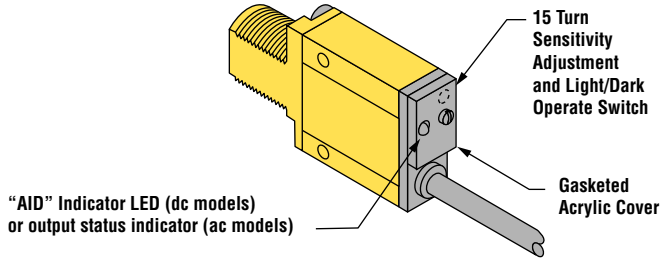


MINI-BEAM AC Sensor with Quick-Disconnect



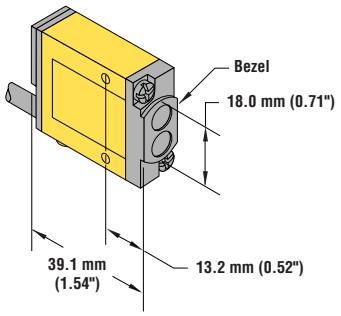
NOTE: The above four drawings apply to model suffix E, EL, EPD, R, RL, RPD, LV, LVAG, LP, D, C, C2, CV, CV2, CV2G, CVG, CVB and CV2B.

MINI-BEAM Sensor - Rear View

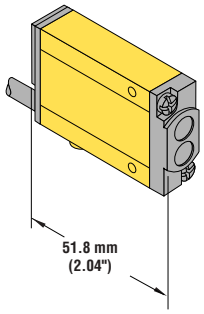


MINI-BEAM Dimensions

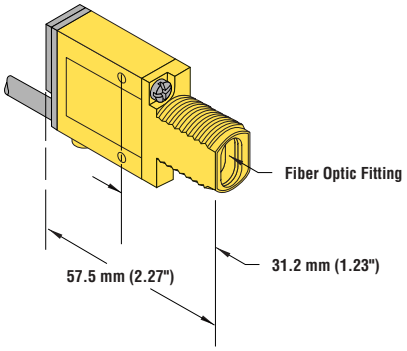
MINI-BEAM DC Sensor - Diffuse Mode (model suffix DBZ and W)



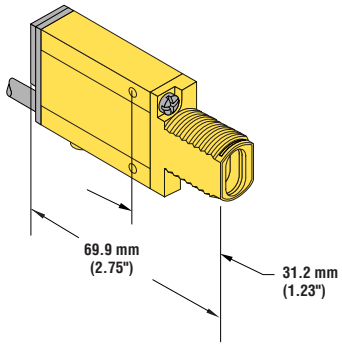
MINI-BEAM AC Sensor - Diffuse Mode (model suffix DBZ and W)



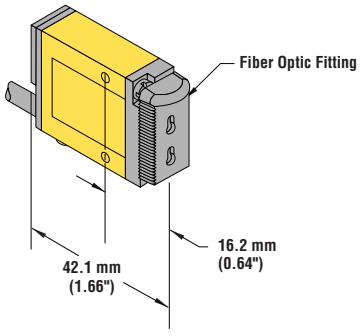
MINI-BEAM DC Sensor - Glass Fiber Optic (model suffix F, FV, FVB & FVG)



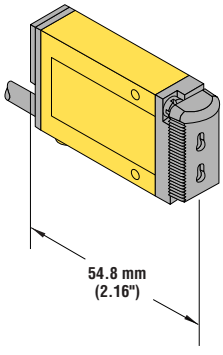
MINI-BEAM AC Sensor - Glass Fiber Optic (model suffix F & FV)



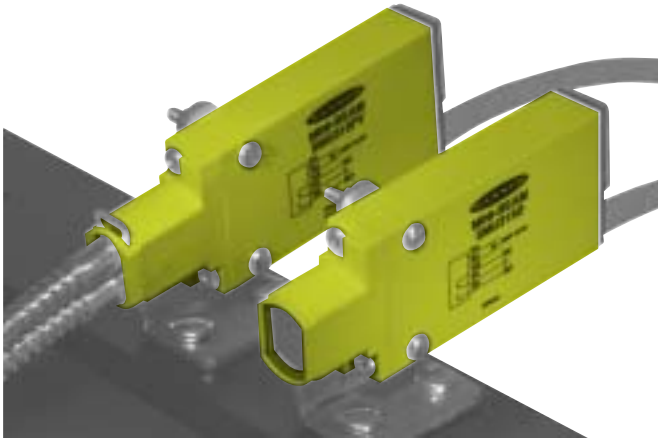
MINI-BEAM DC Sensor - Plastic Fiber Optic (model suffix FP, FPB & FPG)



MINI-BEAM AC Sensor - Plastic Fiber Optic (model suffix FP)



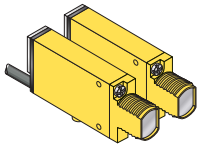
MINI-BEAM Universal Voltage Sensors



*U.S. Patent no. 4356393

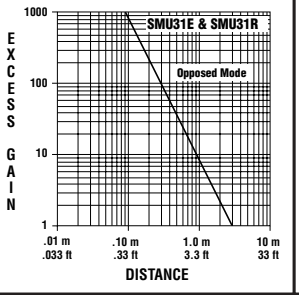
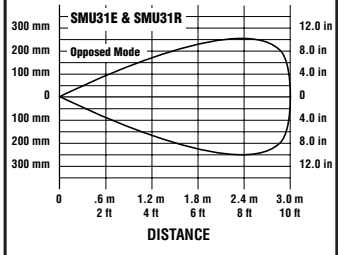
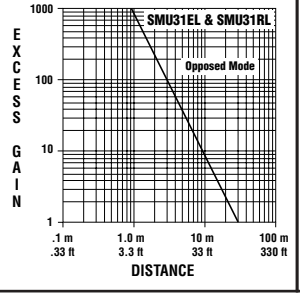
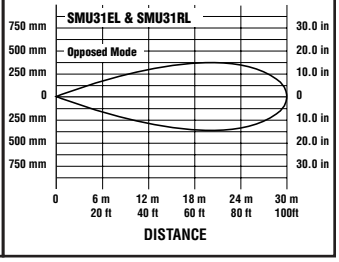
- Universal supply voltage: 24 to 240V ac or 24 to 240V dc
- Easy to install with few necessary adjustments
- 3-amp SPDT electromechanical relay
- Exclusive* Alignment Indicating Device system (AID™) lights a rear panel LED whenever sensing light is detected; superimposed pulse rate indicates received light signal strength
- Wide array of mounting options
- Integral, unterminated cables 2 m (6.5') or 9 m (30') long

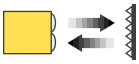
MINI-BEAM Universal Voltage Sensing Mode Options



Infrared, 880 nm

Universal Voltage Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMU31E **SMU31R**	3 m (10')	E: 2-wire 2 m (6.5') R: 5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		
SMU31EL **SMU31RL**	30 m (100')	E: 2-wire 2 m (6.5') R: 5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		

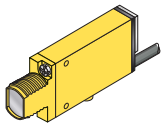


Visible red, 650 nm

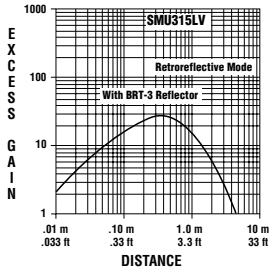
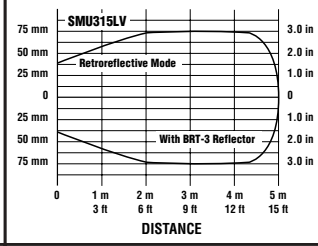
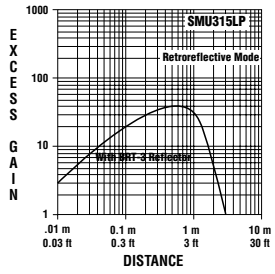
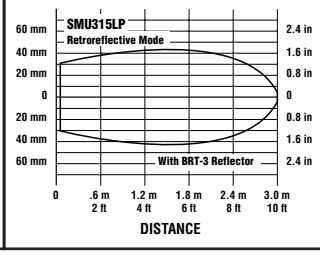
Non-Polarized

Polarized

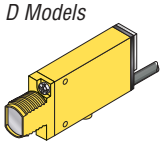
NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



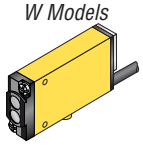
MINI-BEAM Universal Voltage Series Retroreflective Mode

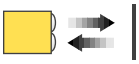
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
SMU315LV	5 m (15')	5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		
Polarized Extended Range						
SMU315LP	10 mm to 3 m (0.4" to 10')	5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		

D Models



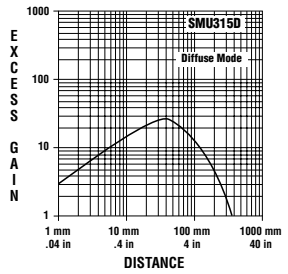
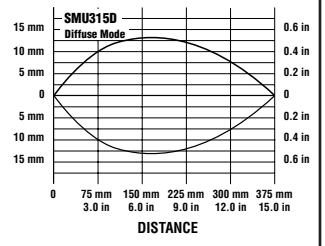
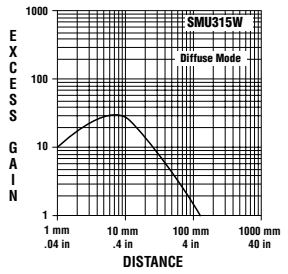
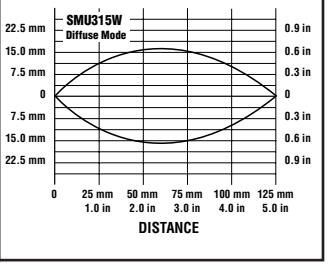
W Models

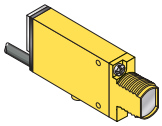


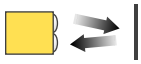


Infrared, 880 nm

MINI-BEAM Universal Voltage Series Diffuse Mode

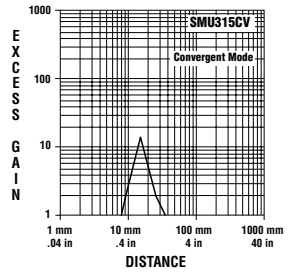
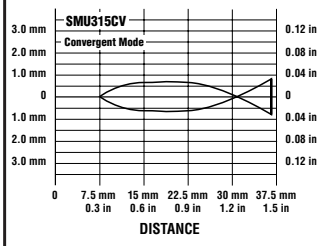
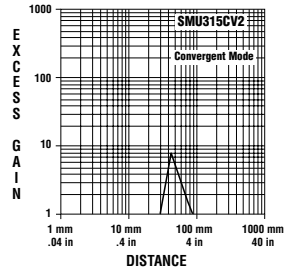
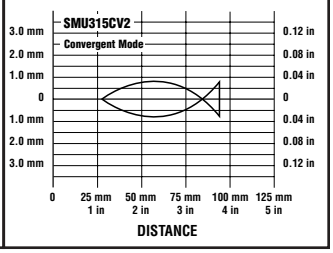
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SMU315D	380 mm (15")	5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		
Divergent Diffuse						
SMU315W	130 mm (5")	5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		

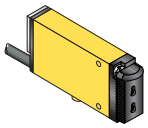




Visible red, 650 nm

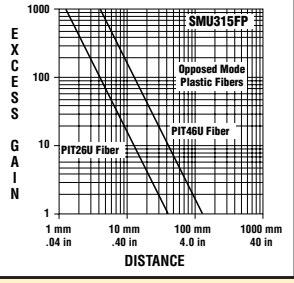
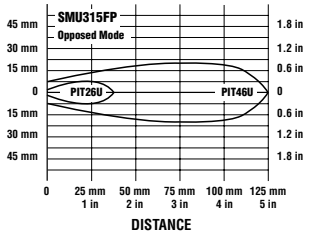
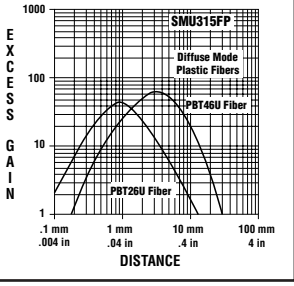
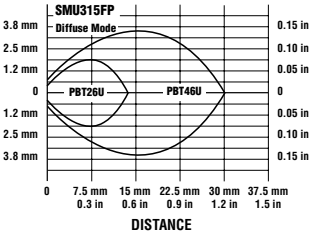
MINI-BEAM Universal Voltage Series Convergent Mode

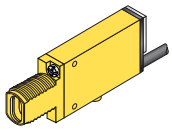
Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Visible Red 650 nm						
SMU315CV	16 mm (0.65") **Spot Size at Focus:** 1.3 mm (0.05")	5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		
SMU315CV2	43 mm (1.7") **Spot Size at Focus:** 3.0 mm (0.12")	5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		



Visible red, 650 nm

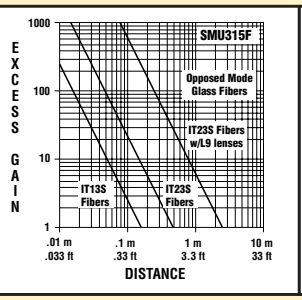
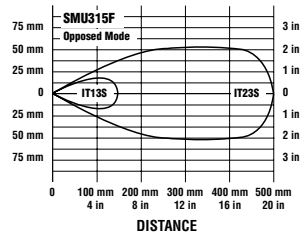
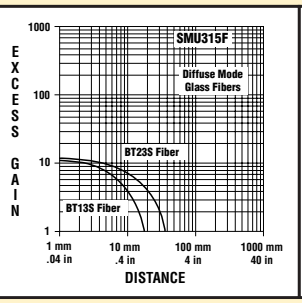
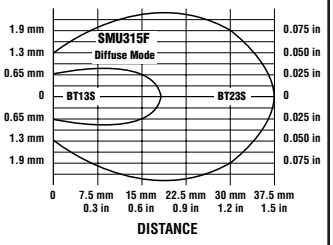
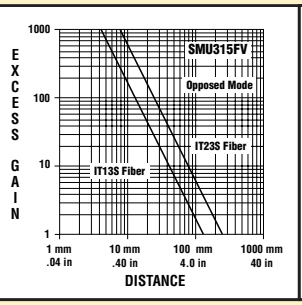
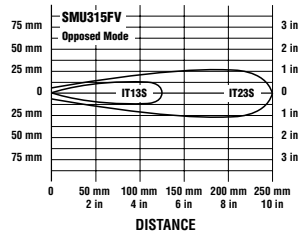
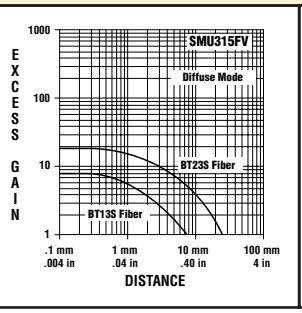
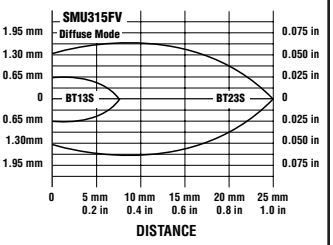
MINI-BEAM Universal Voltage Series Plastic Fiber Optic Sensors

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Visible Red 650 nm					OPPOSED MODE – INDIVIDUAL FIBERS	
SMU315FP	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		
					DIFFUSE MODE – BIFURCATED FIBERS	
						



See Sensing Beam Information Below

MINI-BEAM Universal Voltage Series Glass Fiber Optic Sensors

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Infrared 880 nm					OPPOSED MODE – INDIVIDUAL FIBERS	
SMU315F	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		
					DIFFUSE MODE – BIFURCATED FIBERS	
						
Visible Red 650 nm					OPPOSED MODE – INDIVIDUAL FIBERS	
SMU315FV	Range varies by sensing mode and fiber optics used	5-wire 2 m (6.5')	Universal 24 to 240V dc or 24 to 240V ac	SPDT Electro-mechanical Relay		
					DIFFUSE MODE – BIFURCATED FIBERS	
						

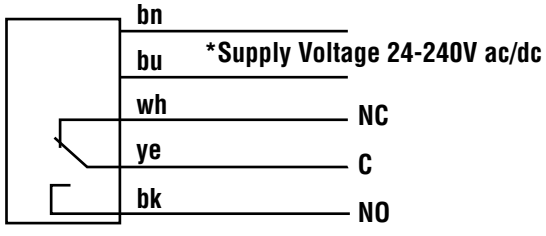
NOTE: i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g., **SMU315FV W/30**)

MINI-BEAM Universal Voltage Series Specifications

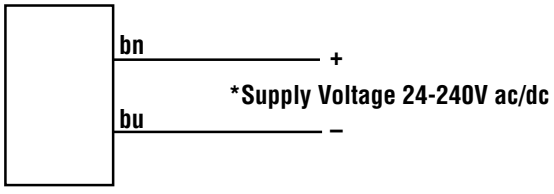
Supply Voltage and Current	**Universal voltage:** 24 to 240V ac, 50/60Hz or 24 to 240V dc (1.5 watts or 2.5 VA maximum)
Supply Protection Circuitry	Protected against transient voltages. DC hookup is without regard to polarity.
Output Configuration	SPDT (Single-Pole, Double Throw) (form C) electromechanical relay, ON/OFF output.
Output Rating	**Maximum switching power (resistive load):** 90W, 250VA **Maximum switching voltage (resistive load):** 250V ac or 30V dc **Maximum switching current (resistive load):** 3A **Minimum voltage and current:** 5V dc, 10 mA **Mechanical life:** 20,000,000 operations **Electrical life at full resistive load:** 100,000 operations
Output Protection Circuitry	Protected against false pulse on power-up.
Output Response Time	**Closure time:** 20 milliseconds max. **Release time:** 20 milliseconds max. **Maximum switching speed:** 25 operations per second
Repeatability	**All sensing modes:** 1 millisecond
Adjustments	Light/Dark Operate select switch, and 15-turn slotted brass screw Gain (sensitivity) adjustment potentiometer (clutched at both ends of travel). Both controls are located on rear panel of sensor and are protected by a gasketed, clear acrylic cover.
Indicators	Exclusive, patented Alignment Indicator Device system (AID™ US patent #4356393) lights a rear-panel-mounted LED indicator whenever the sensor sees a “light” condition, with a superimposed pulse rate proportional to the light signal strength (the stronger the signal, the faster the pulse rate).
Construction	Reinforced thermoplastic polyester housing, totally encapsulated, o-ring seal, acrylic lenses, and stainless steel screws.
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 12, and 13; IEC IP67.
Connections	PVC-jacketed 5-conductor 2 m (6.5') or 9 m (30') unterminated cable. Opposed mode emitter cables are 2-conductor.
Operating Conditions	**Temperature:** -20° to +55°C (-4° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Install transient suppressor (MOV) across contacts switching inductive loads.

MINI-BEAM Universal Voltage Series Hookup Diagrams

All models except Emitters



Emitters

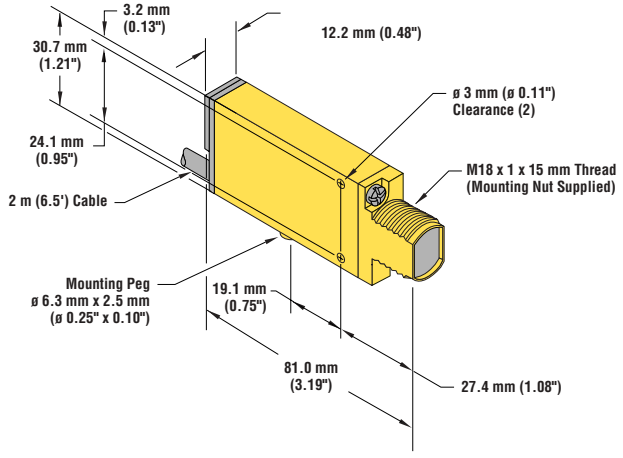


NOTE: Install transient suppressor (MOV) across contacts switching inductive loads.

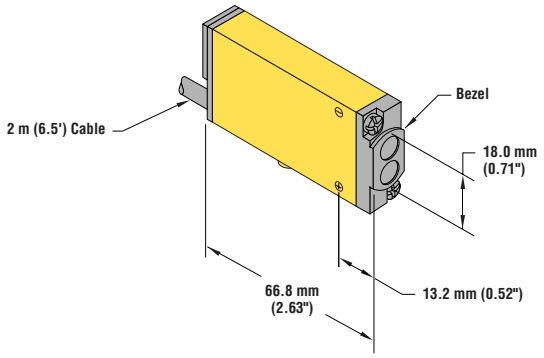
* Connection of DC power is without regard to polarity

MINI-BEAM Universal Voltage Series Dimensions

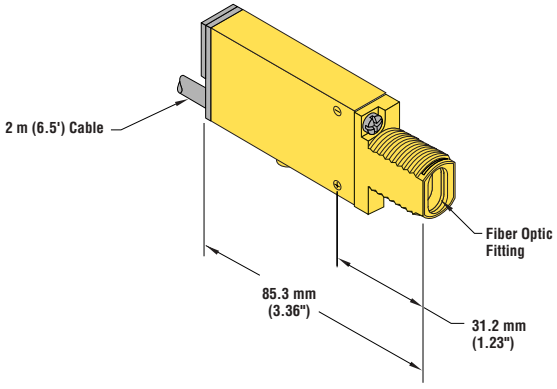
MINI-BEAM Universal Voltage Series Sensor Opposed, Retroreflective, Diffuse, and Convergent Modes (models with suffix E, EL, R, RL, LP, LV, D, CV, CV2)



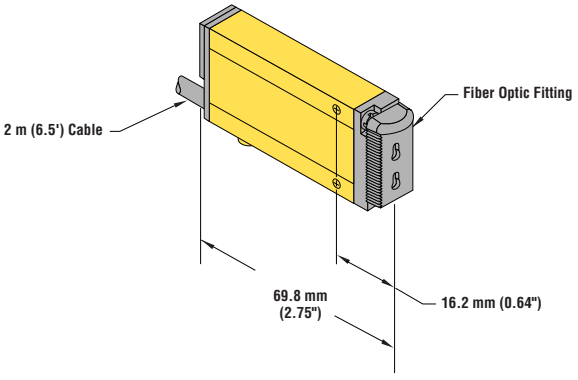
MINI-BEAM Universal Voltage Series Sensor Divergent Diffuse Mode (models with suffix W)



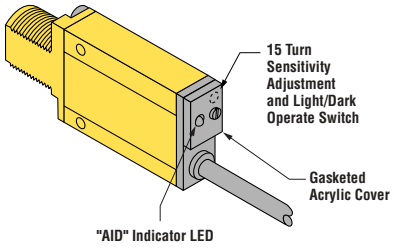
MINI-BEAM Universal Voltage Series Sensor Glass Fiber Optic (models with suffix F and FV)



MINI-BEAM Universal Voltage Series Sensor Plastic Fiber Optic (models with suffix FP)

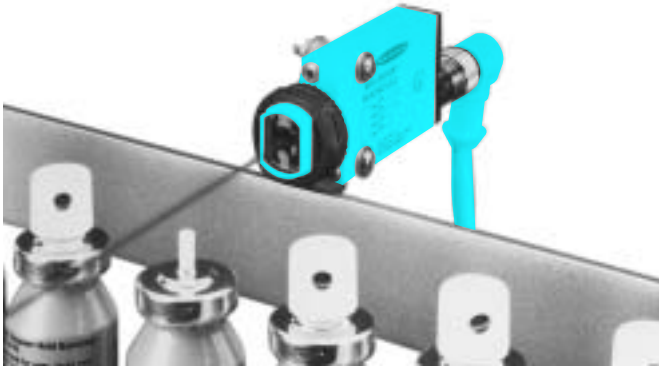


Universal Voltage Sensor - Rear View



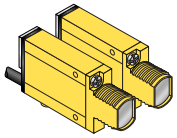
NAMUR Intrinsically Safe DC Sensors

Model MIAD9CVQ shown with accessory model SMB312S bracket and optional MQD9-415RA QD cable



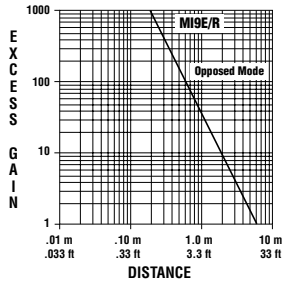
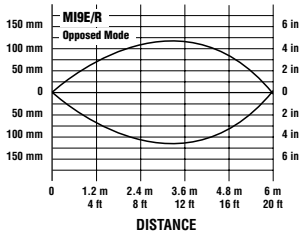
- Intrinsically safe sensors offering MINI-BEAM performance and small size
- Use with approved switching amplifiers which have intrinsically safe input circuits
- Output passes ≤ 1.2 mA in the “dark” condition and ≥ 2.1 mA in the “light” condition
- Choose models with integral cable or quick disconnect connector

NAMUR Sensing Mode Options



Infrared, 880 nm

NAMUR Opposed Mode Emitter (E) and Receiver (R)

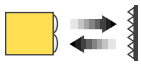
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
MI9E **MIAD9R** **MI9EQ** **MIAD9RQ**	6 m (20') 	2 m (6.5') 2 m (6.5') 4-Pin Euro QD 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		Effective Beam: 13 mm 

For NAMUR MINI-BEAMs:

i) 9 m (30') cables are available by adding suffix **“W/30”** to the model number of any cabled sensor (e.g. - **MIAD9R W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 152 and the Accessories section for more information.

iii) The MINI-BEAM mounting bracket shown in the photographs is optional. See page 152 for bracket information.

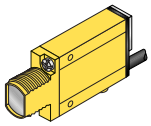


Visible red, 650 nm

Non-Polarized

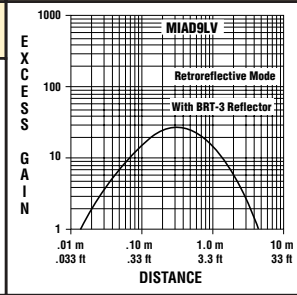
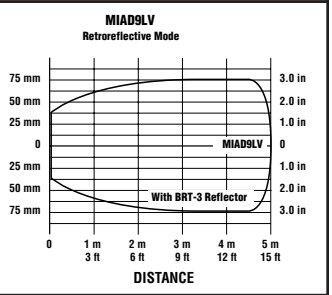
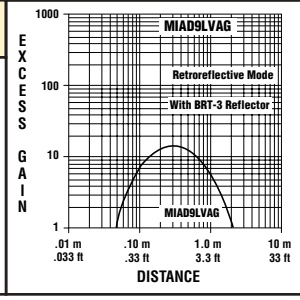
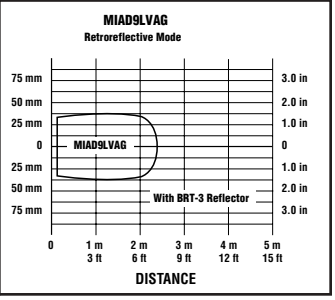
Polarized

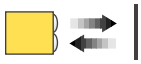
NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



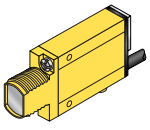
Non-Polarized, Polarized

NAMUR Retroreflective Mode

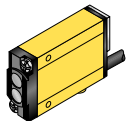
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
MIAD9LV **MIAD9LVQ**	5 m (15')	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		
Polarized						
MIAD9LVAG **MIAD9LVAGQ**	50 mm to 2 m (2" to 7')	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		



Infrared, 880 nm

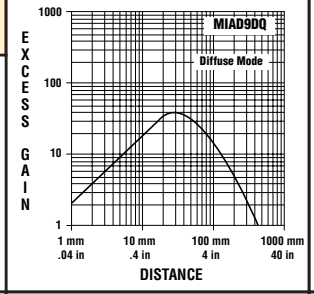
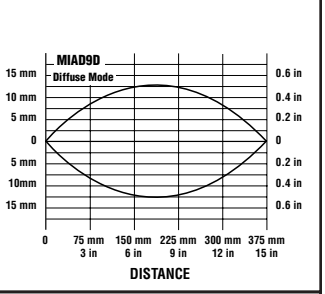
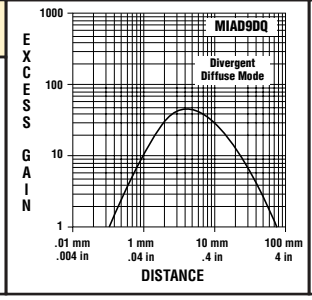
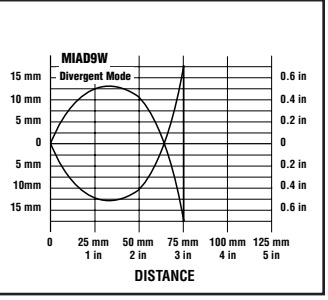


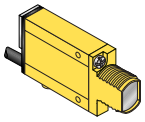
Diffuse

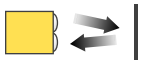


Divergent Diffuse

NAMUR Diffuse Mode

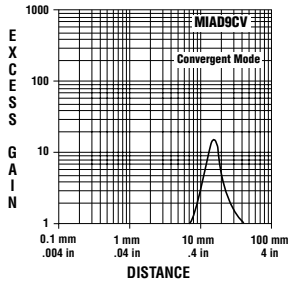
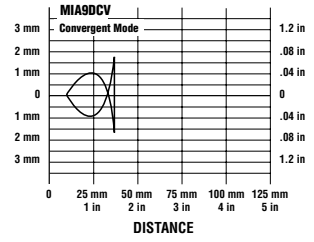
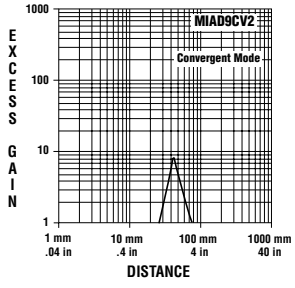
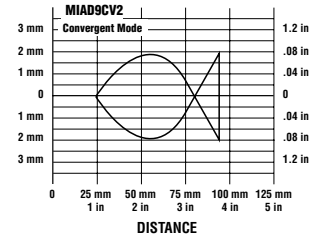
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain Performance based on 90% reflectance white test card	Beam Pattern Performance based on 90% reflectance white test card
Diffuse						
MIAD9D **MIAD9DQ**	380 mm (15")	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		
Divergent Diffuse						
MIAD9W **MIAD9WQ**	75 mm (3")	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		

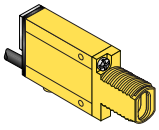




Visible red, 650 nm

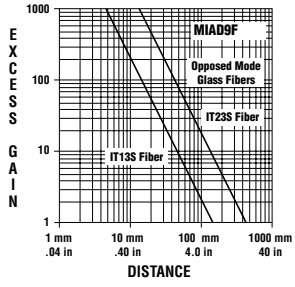
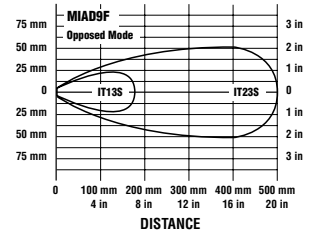
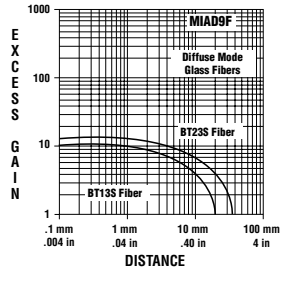
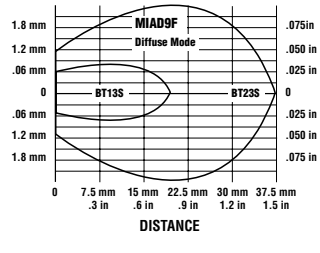
NAMUR Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
MIAD9CV **MIAD9CVQ**	16 mm (0.65")	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		
MIAD9CV2 **MIAD9CV2Q**	43 mm (1.7")	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		



Infrared, 880 nm

NAMUR Glass Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
MIAD9F **MIAD9FQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		
						

NAMUR Specifications

Supply Voltage	5 to 15V dc (provided by the amplifier to which the sensor is connected)
Output	Constant current output: ≤1.2 mA in the "dark" condition and ≥2.1 mA in the "light" condition
Output Response Time	Opposed mode receiver: 2 milliseconds on/400 µs off; all other models: 5 milliseconds on/off (does not include amplifier response)
Adjustment	15-turn slotted brass screw GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel); located on rear panel and protected by a clear gasketed acrylic cover
Indicator	Red LED alignment indicator located on rear panel lights when the sensor sees a "light" condition
Construction	Reinforced thermoplastic polyester housing, totally encapsulated, o-ring sealing, acrylic lenses, and stainless steel screws
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 12 and 13; IEC IP67
Connections	PVC-jacketed 2-conductor 2 m (6.5') or 9 m (30') cables, or 4-pin euro-style quick-disconnect (QD) fitting are available; QD cables are ordered separately (see page 152 and Accessories section)
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum Relative Humidity:** 90% at 50°C (non-condensing)
Design Standards	MIAD9 Series sensors comply with the following standards: DIN 19 234, EN 50 014 Part 1. 1977, EN50 020 Part 7. 1977, Factory Mutual #3610 and 3611, CSA 22.2 #157-92 and 22.2 #213-M1987
Certifications	CE, CSA Exia ® NRTL/C, Ex KEMA, ETL LISTED 107674, FM APPROVED

APPROVALS

CSA:	#LR 41887	Instrinsically Safe, with Entity for: Class I, Groups A-D Class I, Div. 2, Groups A-D
FM:	#J.I. 5Y3A4.AX	Intrinsically Safe, with Entity for: Class I, II, III, Div. 1, Groups A-G Class I, II, III, Div. 2, Groups A-D and G
KEMA:	#Ex-94.C.7937	EEx ia IIC T6
ETL:	#553868	

For NAMUR MINI-BEAMs:

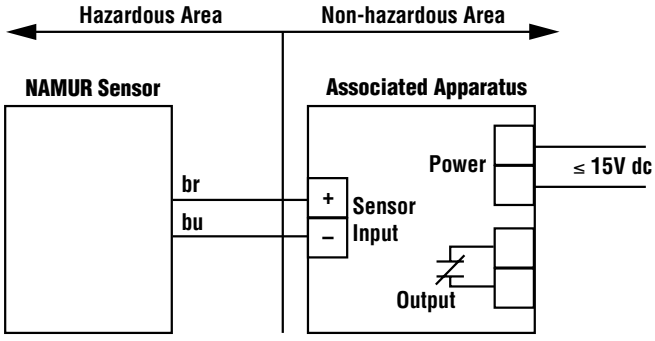
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **MIADCV W/30**)

ii) A model with a QD connector requires an accessory MQD9-4xx mating cable. See pages 152 and the Accessories section for more information.

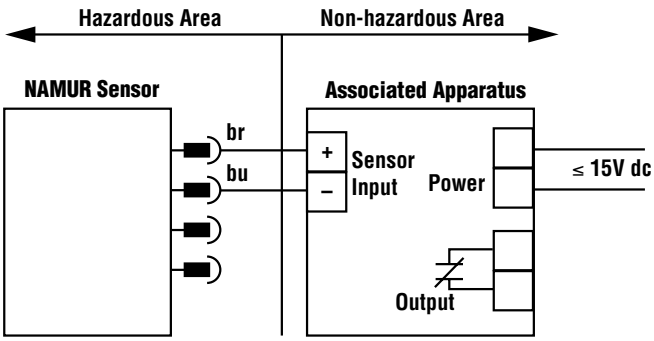
iii) The MINI-BEAM mounting bracket shown in the photographs is optional. See page 155 for bracket information.

NAMUR Hookup Diagrams

Sensors with Attached Cable



Sensors with Quick-Disconnect



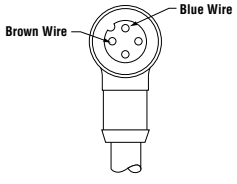
Entity Parameters

Associated Apparatus	Sensor
V_{oc} ≤ 15V dc	V_{max} = 15V dc
I_{sc} ≤ 60 mA	I_{max} = 60 mA
C_a ≤ *C(cable) + Ci	C_i = 0
L_a ≤ *L(cable) + Li	L_i = 0
$^*C_{(cable)}$ = 60 pF/ft	$^*L_{(cable)}$ = 0.2 µH/ft

Application Notes

The "Associated Apparatus" may include intrinsically safe amplifiers and barriers to monitor the sensor supply current, which is the sensor's output signal. The associated apparatus must limit both supply voltage and supply current in the event of failure.

Euro-Style Pin-out (Cable Connector Shown)



Quick-Disconnect (QD) Option for NAMUR Sensors

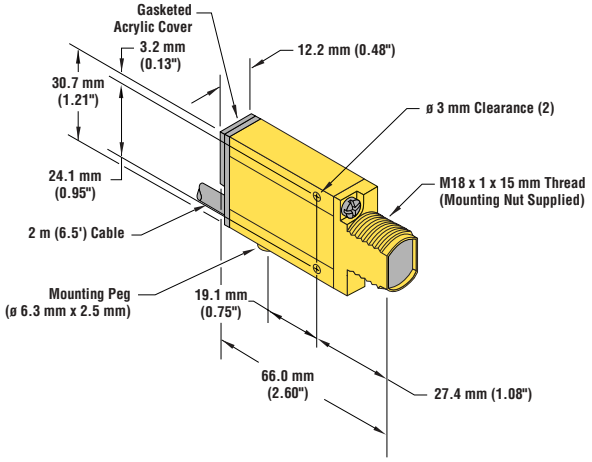
MINI-BEAM series MIAD9 NAMUR sensors are sold with either a 2 m (6.5') or 9 m (30') attached PVC-covered 2-wire cable or with a 4-pin QD cable fitting.

NAMUR QD sensors are identified by the "Q" in their model number suffix, and are provided with a 4-pin Euro type connector. Mating cables for NAMUR QD sensors are models MQD9-415 (straight connector) or MQD9-415RA (right angled connector). Mating QD cables are 5 m (15') long and must be ordered separately from the sensor. For more information on QD cables, see page 152 and the Accessories section.

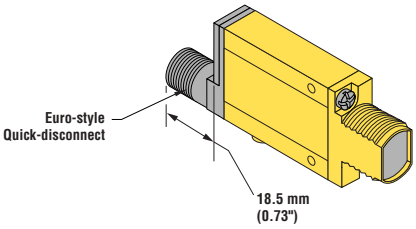
NAMUR Dimensions

NAMUR Opposed, Retro, Diffuse and Convergent Sensing Modes (model suffix E, R, LV, LVAG, D, CV & CV2)

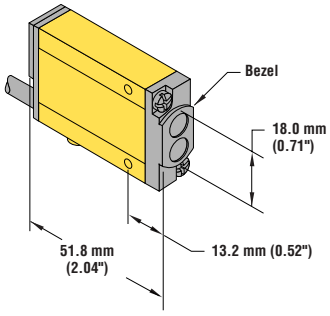
NAMUR Sensor with Attached Cable



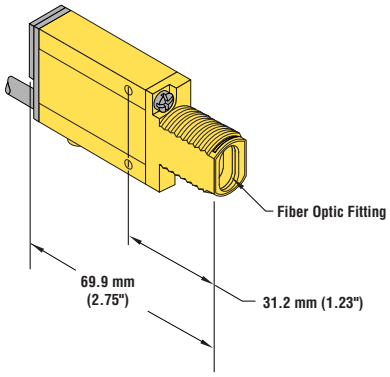
NAMUR Sensor with Quick-Disconnect



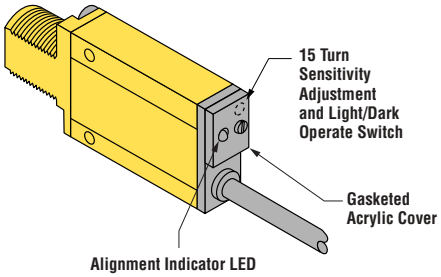
NAMUR Divergent Diffuse Sensing Mode (model suffix W)



NAMUR Glass Fiber Optic Sensing (model suffix F)



NAMUR Sensor - Rear View



Modifications

Model Suffix	Modification	Description		Example of Model Number
W/30	9 m (30') cable	All MINI-BEAM sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable		SM312LVW/30
MHS	Modified for High Speed	Standard dc MINI-BEAM sensors with 1 millisecond output response may be modified for 0.3 millisecond (300 µs) response. NOTE: Faster response comes at the expense of lower excess gain.		SM312LVMHS
QDP	Pigtail Quick-Disconnect	All MINI-BEAMs may be built with a 150 mm (6") long integral cable which is terminated with the appropriate QD connector. See the Accessories section for more information.		SM312LVQDP

Quick-Disconnect (QD) Cables

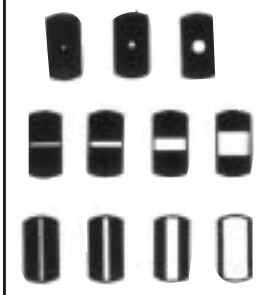
Following is the selection of cables available for MINI-BEAM QD models. See the Accessories section for more cable information.

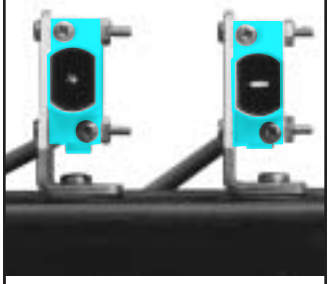
Style	Model	Length	Connector	Used with:
3-Pin Micro	**MQDC-306** **MQDC-315** **MQDC-330** **MQDC-306RA** **MQDC-315RA** **MQDC-330RA**	2 m (6.5') 5 m (15') 9 m (30') 2 m (6.5') 5 m (15') 9 m (30')	Straight Straight Straight Right-angle Right-angle Right-angle	Standard ac MINI-BEAMs with QD connector
4-Pin Euro	**MQDC-406** **MQDC-415** **MQDC-430** **MQDC-406RA** **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30') 2 m (6.5') 5 m (15') 9 m (30')	Straight Straight Straight Right-angle Right-angle Right-angle	Standard dc MINI-BEAMs with QD connector
5-Pin Euro	**MQDC1-506** **MQDC1-515** **MQDC1-530** **MQDC1-506RA** **MQDC1-515RA** **MQDC1-530RA**	2 m (6.5') 5 m (15') 9 m (30') 2 m (6.5') 5 m (15') 9 m (30')	Straight Straight Straight Right-angle Right-angle Right-angle	MINI-BEAM *Expert* Series with QD connector
4-Pin Euro (NAMUR)	**MQD9-406** **MQD9-415** **MQD9-406RA** **MQD9-415RA**	2 m (6.5') 5 m (15') 2 m (6.5') 5 m (15')	Straight Straight Right-angle Right-angle	MIAD9 Series NAMUR sensors with QD connector

Apertures

Opposed mode MINI-BEAM sensors may be fitted with apertures which narrow or shape the effective beam of the sensor to more closely match the size or profile of the object to be sensed. A common example is the use of "line" or "slit" type aperture when wire or thread is be sensed. Each model contains 20 apertures.

Model	Description
AP31-020	0.5 mm (0.02") diameter, circular
AP31-040	1.0 mm (0.04") diameter, circular
AP31-100	2.5 mm (0.10") diameter, circular
AP31-020H	0.5 x 6.4 mm (0.02 x 0.25"), horizontal slotted
AP31-040H	1.0 x 6.4 mm (0.04 x 0.25"), horizontal slotted
AP31-100H	2.5 x 6.4 mm (0.10 x 0.25"), horizontal slotted
AP31-200H	5.1 x 6.4 mm (0.20 x 0.25"), horizontal slotted
AP31-020V	0.5 x 12.7 mm (0.02 x 0.50"), vertical slotted
AP31-040V	1.0 x 12.7 mm (0.04 x 0.50"), vertical slotted
AP31-100V	2.5 x 12.7 mm (0.10 x 0.50"), vertical slotted
AP31-200V	5.1 x 12.7 mm (0.20 x 0.50"), vertical slotted
AP31-DVHX2	Kit containing two of each aperture





Range of MINI-BEAM Opposed Mode Sensor Pairs when used with Apertures

Definitions

GROUP I Emitter/ Receiver Pairs (see RANGE columns at right):
- **SM31E/SM31R**
- **SMA31E/SM2A31R**
- **SM31EM/SM31R**

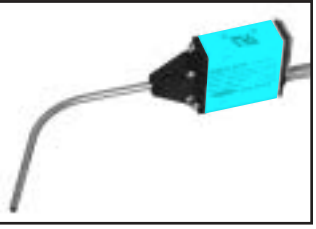
GROUP II Emitter/ Receiver Pairs (see RANGE columns at right):
- **SM31EL/SM31RL**
- **SMA31EL/SM2A31RL**
- **SM31EML/SM31RL**

Example:
The MINI-BEAM SM31E/ SM31R sensor pair is in **Group I**. With an **AP31-040 circular** aperture on the *receiver only*, range is 939.8 mm (37"). With AP31-040 apertures on *both emitter and receiver*, range is 330.2 mm (13"). Group I range with AP31-040 apertures and UC-300EL upper covers on both units is 482.6 mm (19"); range with only receiver apertures is 2032 mm (80").

Aperture(s) Used	RANGE Standard Group I and II Sensor Pairs				RANGE Group I Sensor Pairs with UC-300EL Upper Covers Substituted	
	Emitter & Receiver Both Apertured		Receiver Only Apertured			
	Group I Sensors	Group II Sensors	Group I Sensors	Group II Sensors	Emitter & Receiver Both Apertured	Receiver Only Apertured
AP31-020	89 mm (3.5")	102 mm (4.0")	457 mm (18")	1.5 m (60")	127 mm (5.0")	914 mm (36")
AP31-040	330 mm (13")	457 mm (18")	940 mm (37")	3.2 m (10.5')	483 mm (19")	2.0 m (80")
AP31-100	1.5 m (60")	3.0 m (10')	2.5 m (100")	8.2 m (27')	2.1 m (84")	5.8 m (19')
AP31-020H	406 mm (16")	1.8 m (70")	965 mm (38")	9.1 m (30')	864 mm (34")	3.4 m (11')
AP31-040H	914 mm (36")	4.0 m (13')	1.8 m (72")	12.5 m (41')	1.8 m (72")	5.2 m (17')
AP31-100H	2.3 m (90")	10.4 m (34')	2.9 m (114")	20.7 m (68')	5.2 m (17')	8.5 mm (28')
AP31-200H	2.8 m (110")	21.3 m (70')	3.0 m (120")	24.4 m (80')	8.2 m (27')	11.0 m (36')
AP31-020V	457 mm (18")	1.7 m (65")	1.0 m (40")	8.2 m (27')	1.0 m (40")	3.4 m (11')
AP31-040V	1.0 m (40")	5.5 m (18')	1.8 m (70")	15.8 m (52')	2.1 m (84")	5.5 m (18')
AP31-100V	2.3 m (90")	10.7 m (35')	2.9 m (114")	22.9 m (75')	6.1 m (20')	8.5 m (28')
AP31-200V	2.8 m (110")	22.9 m (75')	3.0 m (120")	25.9 m (85')	8.5 mm (28')	11.0 m (36')

Bendable Bifurcated Plastic Fiber Optic Probes

The following plastic fiber optic probe assemblies are designed to bolt directly onto MINI-BEAM plastic fiber optic (FP) models. These are bifurcated assemblies used in the diffuse sensing mode. Performance is estimated using the excess gain curves for diffuse mode plastic fibers. Standard probe length is 94 mm (3.7"). Longer and shorter probe lengths may be quoted. Probes are annealed stainless steel, and are bendable at the center of their length.

Model	Description	
FPA20	• 0.5 mm (0.02") diameter bifurcated fiber • Performance is equivalent to fiber model PBT26U	
FPA40	• 1.0 mm (0.04") diameter bifurcated fiber • Performance is equivalent to fiber model PBT46U	

Right-Angle Reflectors

MINI-BEAM right-angle reflectors are useful for tight sensing locations. NOTE: These reflectors significantly decrease excess gain.

Model	Description	
RAR300SM	• Side mount reflector that attaches to the MINI-BEAM with two #4 screws (supplied) • Creates a sensor which measures only 14 mm (0.56") in the direction of the scan • Use with sensor models 31E, EL, R, RL; 312D, DBZ, LV and W	
RAR300FM	• Front mount reflector that attaches directly to the threaded barrel of most MINI-BEAMs • Creates a sensor profile dimension in the direction of the scan that is 34 mm (1.35") • Use with sensor models 31E, EL, R, RL, 312D, and LV	

Replacement Lens Assemblies

MINI-BEAM lens assemblies are field-replaceable. In addition, some lenses may be used to convert from one sensing mode to another, or to change the sensing range of a particular sensor. The possible conversions are listed in the table below.

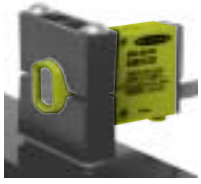
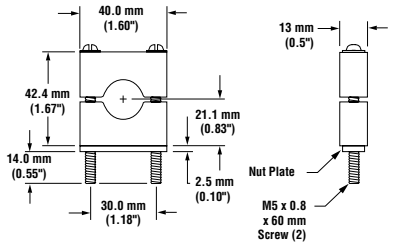
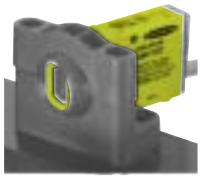
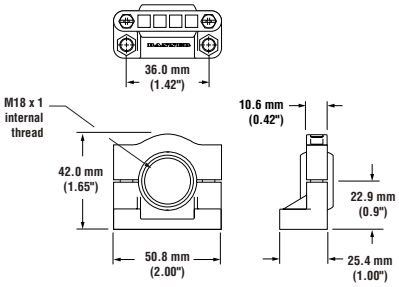
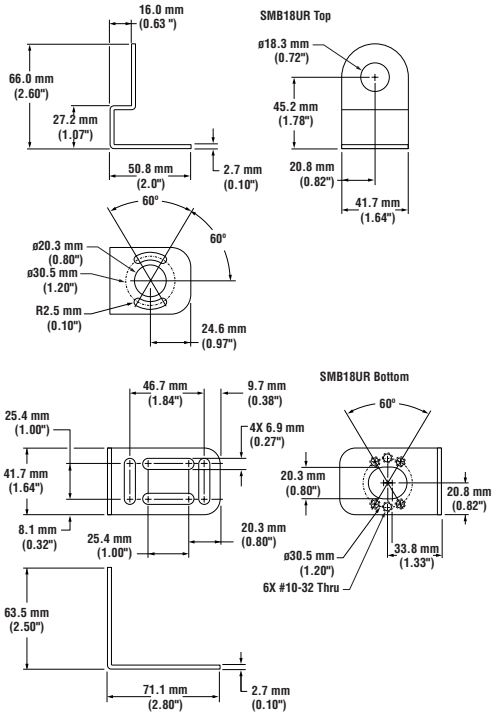
Model	Description	Possible Sensing Mode or Range Changes	
UC-300AG	Replacement lens for LVAG	Change LV to LVAG	
UC-300BZ	Replacement lens for W and DBZ	Change D to DBZ and F to DBZ	
UC-300C.7	Replacement lens for C, CV and CVG	Change CV2 to CV	
UC-300C2	Replacement lens for C2 and CV2	Change CV to CV2	
UC-300E	Replacement lens for E, & R	—	
UC-300EL	Replacement lens for EL, & RL	Extend range of E/R	
UC-300EPD	Replacement lens for EPD	—	
UC-300F	Replacement lens for F and FV	Change D to F and DBZ to F	
UC-300FP	Replacement lens for FP (Old style)	—	
UC-300FP2	Replacement lens for FP	—	
UC-300L	Replacement lens for LV and D	Change F to D, LVAG to LV and DBZ to D	
UC-300LP	Replacement lens for LP	—	
UC-300RPD	Replacement lens for RPD	—	

Extension Cables (without connectors)

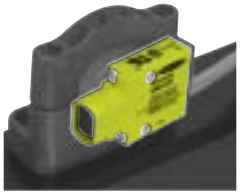
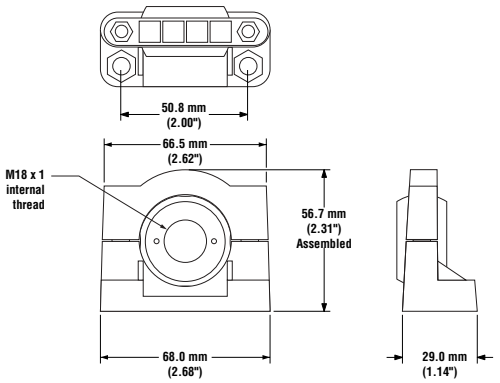
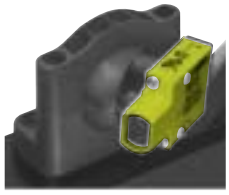
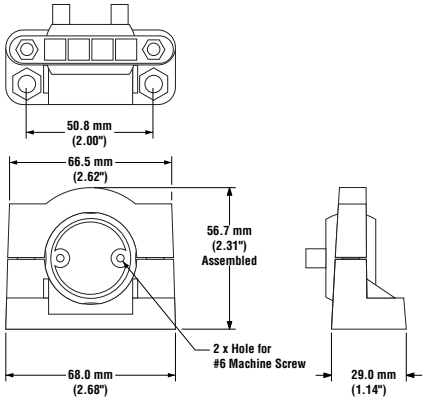
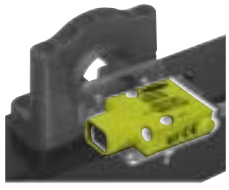
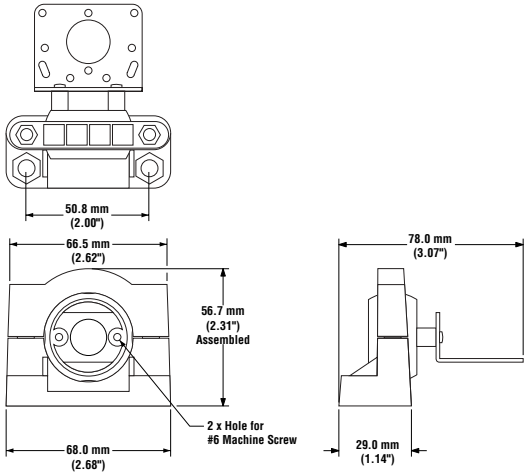
The following cables are available for extending the length of existing sensor cable. These are 30 m (100') lengths of MINI-BEAM cable. This cable may be spliced to existing cable. Connectors, if used, must be customer-supplied.

Model	Type	Used with:
EC312A-100	2-conductor	MINI-BEAM emitters, SM2A312 ac models
EC312-100	4-conductor	All MINI-BEAM SM312 dc models, except emitters
ECAD9-100	2-conductor	MINI-BEAM NAMUR models

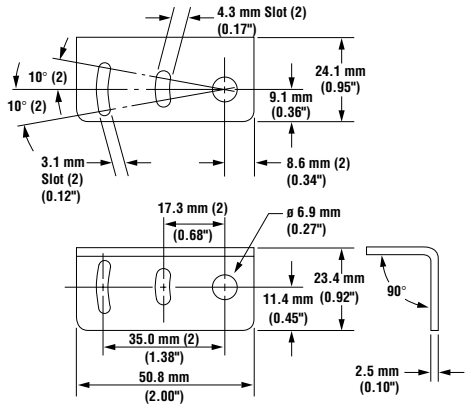
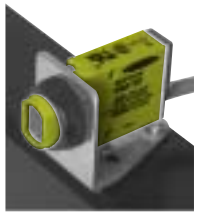
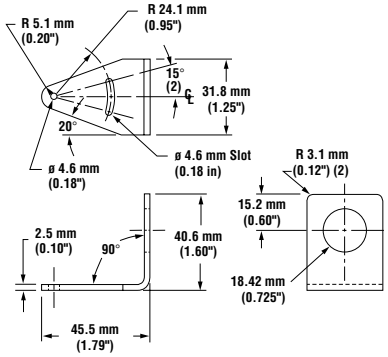
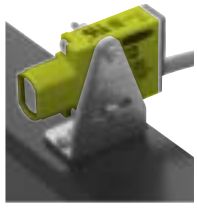
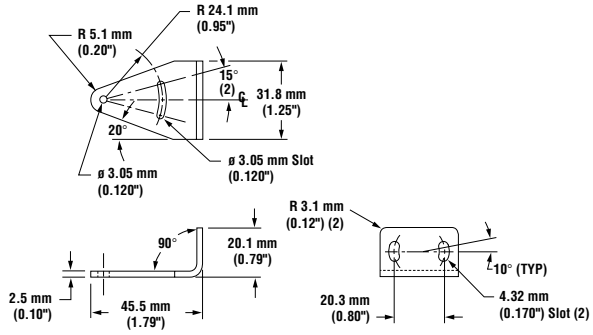
Mounting Brackets

Model	Description	Dimensions
SMB18C 	• 18 mm split clamp bracket • Black thermoplastic polyester • Includes stainless steel mounting hardware	
SMB18SF 	• 18 mm swivel bracket • Black thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB18UR 	• 2-part universal rotating bracket • Stainless steel	

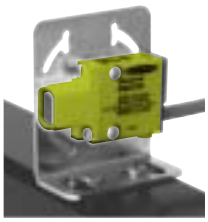
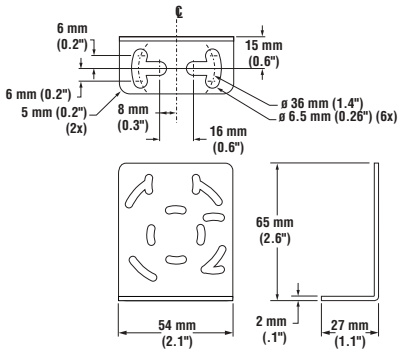
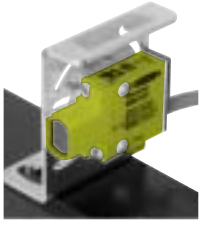
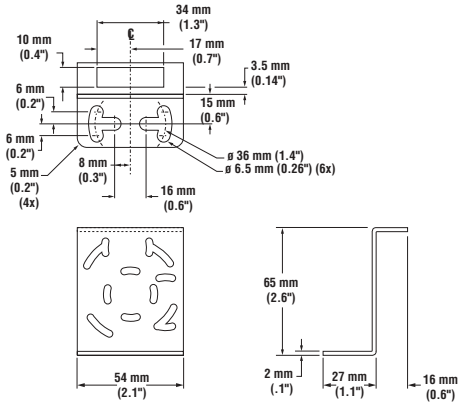
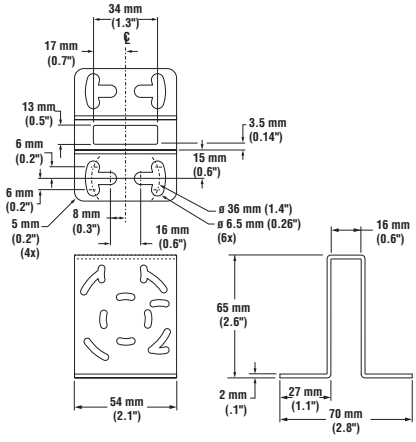
Mounting Brackets

Model	Description	Dimensions
SMB3018SC 	• 18 mm swivel barrel or side mount bracket • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB30SUS 	• Side mount swivel bracket – extended range of motion • Black thermoplastic polyester	
SMB30SK 	• Flat-mount swivel bracket with extended range of motion • Black reinforced thermoplastic polyester and 316 stainless steel • Includes stainless steel swivel locking hardware	

Mounting Brackets

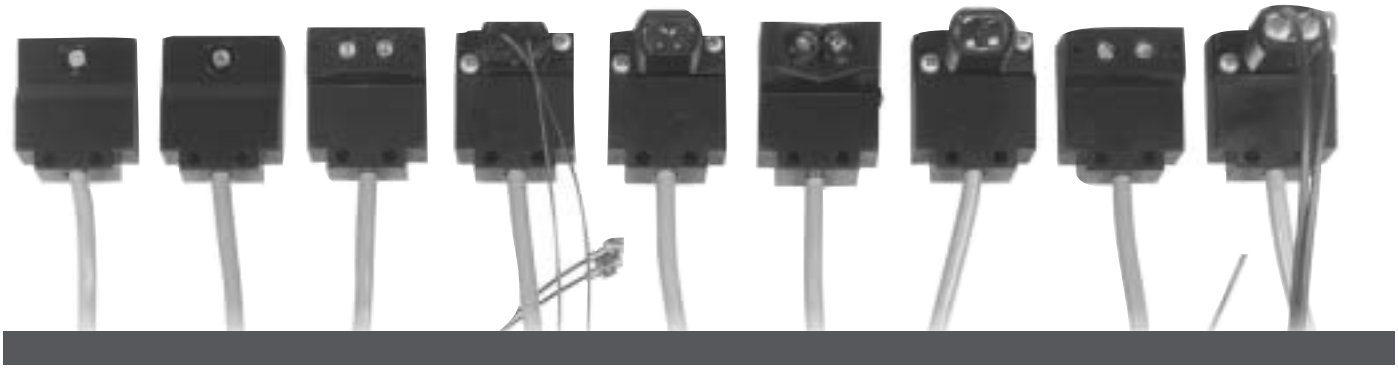
Model	Description	Dimensions
SMB312B 	• Stainless steel 2-axis, bottom mounting bracket • Includes mounting foot	
SMB312PD 	• Stainless steel 18 mm barrel mounting bracket	
SMB312S 	• Stainless steel 2-axis, side mounting bracket	

Mounting Brackets

Model	Description	Dimensions
SMB46L 	• "L" bracket • 14-gauge 316 stainless steel	
SMB46S 	• "S" bracket • 14-gauge 316 stainless steel	
SMB46U 	• "U" bracket • 14-gauge 316 stainless steel	

Retroreflective Targets

Banner offers a wide selection of high-quality retroreflective targets. See Accessories section for complete information.



ECONO-BEAM® Sensors

CE cULus

ECONO-BEAM sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

ECONO-BEAM Sensors

Miniature Self-Contained AC and DC Sensors

ECONO-BEAM ac sensors shown

- Select 4-wire dc or 3-wire ac models
- DC models have bipolar outputs (one NPN and one PNP); each output rated at 150 milliamps
- AC models have SPST solid-state (FET) output switch rated at 300 milliamps
- Choose models for light operate or dark operate
- 2 m (6.5') is standard cable length; 9 m (30') is also available

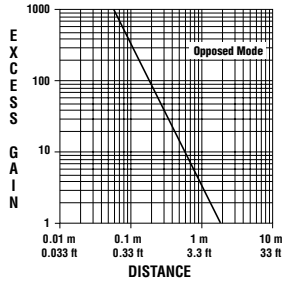
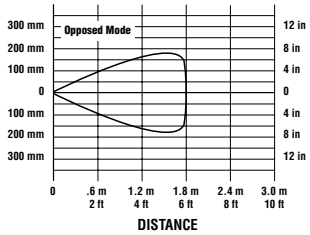
ECONO-BEAM Sensing Mode Options

DC Model

AC Model

Infrared, 880 nm

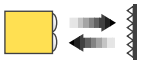
ECONO-BEAM Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SE61E **SE61R**	1.8 m (6')	2 m (6.5')	10-30V dc	Bipolar NPN/PNP LO		Effective Beam: 3 mm 
SE61E **SE61RNC**				Bipolar NPN/PNP DO		
SE611E **SE61AW1R**		2 m (6.5')	120V ac	SPST Solid-state LO		
SE611E **SE61RW1R**				SPST Solid-state DO		

For ECONO-BEAMS:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SE61RNC W/30**)

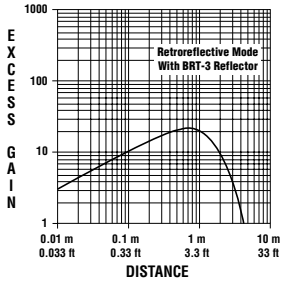
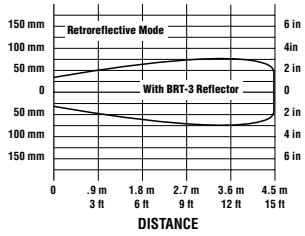
ii) For dc models, no suffix means light operate and suffix "NC" means dark operate. For ac models, "AW" indicates light operate and "RW" means dark operate.

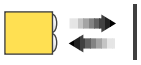


Visible red, 650 nm

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

ECONO-BEAM Non-Polarized Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SE612LV	4.5 m (15')	2 m (6.5')	10-30V dc	Bipolar NPN/PNP LO		
SE612LVNC				Bipolar NPN/PNP DO		
SE61AW1LV		2 m (6.5')	120V ac	SPST Solid-state LO		
SE61RW1LV				SPST Solid-state DO		

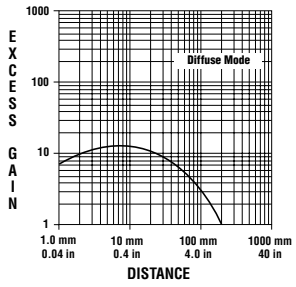
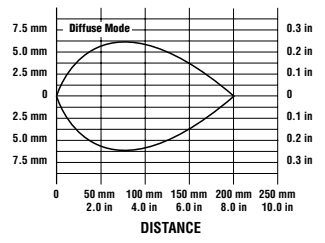
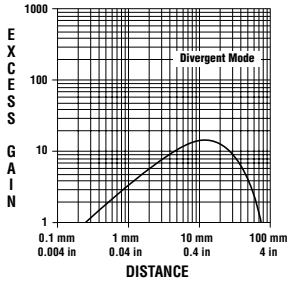
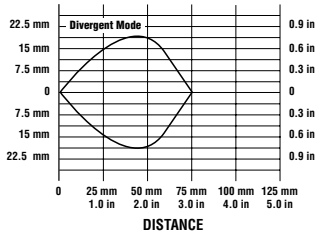


Infrared, 880 nm

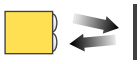
DC Model

AC Model

ECONO-BEAM Diffuse Mode

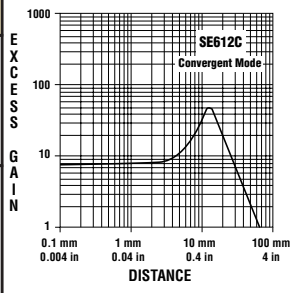
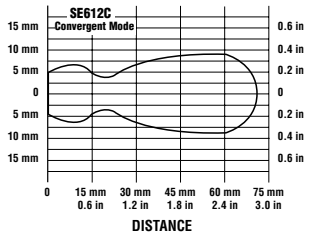
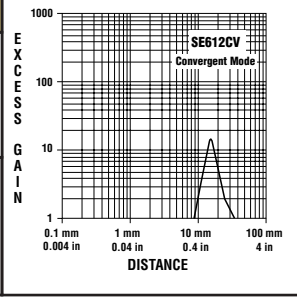
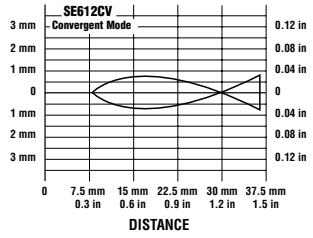
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SE612D	200 mm (8")	2 m (6.5')	10-30V dc	Bipolar NPN/PNP LO		
SE612DNC				Bipolar NPN/PNP DO		
SE61AW1D		2 m (6.5')	120V ac	SPST Solid-state LO		
SE61RW1D				SPST Solid-state DO		
Divergent Diffuse*						
SE612W	76 mm (3")	2 m (6.5')	10-30V dc	Bipolar NPN/PNP LO		
SE612WNC		2 m (6.5')		Bipolar NPN/PNP DO		

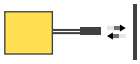
*Note: Divergent diffuse models are recommended for sensing clear materials.



See Sensing Beam Information Below

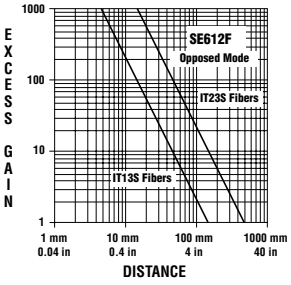
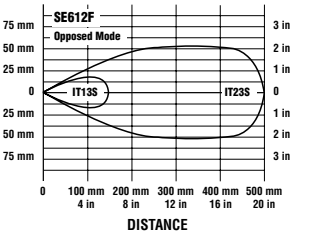
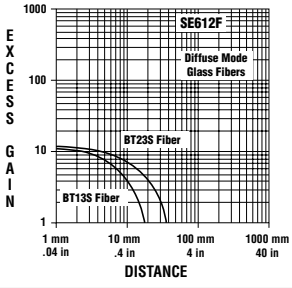
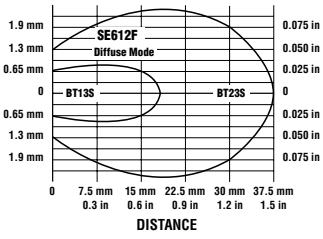
ECONO-BEAM Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Infrared 940 nm						
SE612C	12 mm (0.5")	2 m (6.5')	10-30V dc	Bipolar NPN/PNP LO		
SE612CNC				Bipolar NPN/PNP DO		
Visible Red 650 nm						
SE612CV	16 mm (0.65") Spot Size at Focus: 1.2 mm (0.05")	2 m (6.5')	10-30V dc	Bipolar NPN/PNP LO		
SE612CVNC				Bipolar NPN/PNP DO		



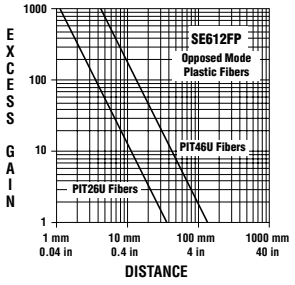
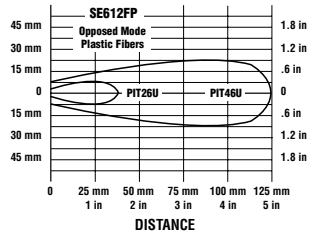
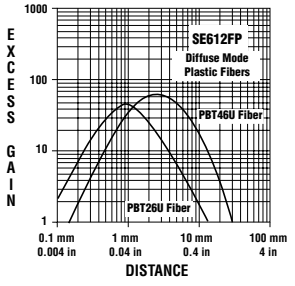
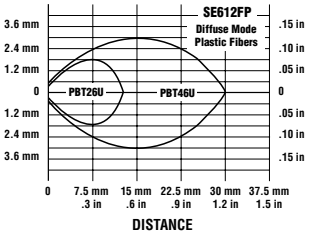
Infrared, 880 nm

ECONO-BEAM Glass Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
SE612F	Range varies by sensing mode and fiber optics used	2 m (6.5')	10-30V dc	Bipolar NPN/PNP LO		
SE612FNC				Bipolar NPN/PNP DO		

Visible red, 650 nm

ECONO-BEAM Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
SE612FP	Range varies by sensing mode and fiber optics used	2 m (6.5')	10-30V dc	Bipolar NPN/PNP LO		
SE612FPNC				Bipolar NPN/PNP DO		

For ECONO-BEAMS:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SE612FPNC W/30**)

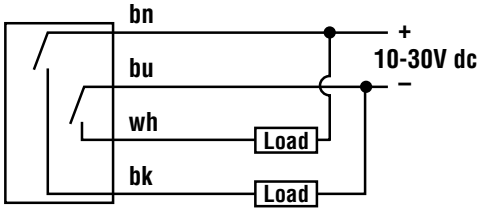
ii) For dc models, no suffix means light operate and suffix "NC" means dark operate.

ECONO-BEAM DC Specifications

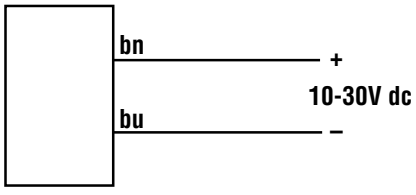
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 20 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	150 mA maximum each output **Off-state leakage current** less than 1 microamp **Output saturation voltage** (PNP output) less than 1 volt at 10 mA and less than 2 volts at 150 mA **Output saturation voltage** (NPN output) less than 200 millivolts at 10 mA and less than 1 volt at 150 mA
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	Less than 10 milliseconds ON and OFF; independent of signal strength (NOTE: 100 millisecond delay on power-up: outputs are non-conducting during this time.)
Repeatability	0.4 ms; MHS models 0.06 ms; independent of signal strength.
Indicators	All models except emitter-only units have a top-mounted LED indicator that lights whenever the receiver "sees" its modulated light source.
Construction	Reinforced thermoplastic polyester (models LV, CV, F and FP) or polycarbonate (other models) housing, totally encapsulated for protection against moisture, vibration and corrosion.
Environmental Rating	Meets NEMA standards 1, 3, 3S, 4, 4X, 12, and 13; IEC IP66
Connections	PVC-jacketed 4-wire 2 m (6.5') or 9 m (30') cables
Operating Conditions	**Temperature:** 0° to 50°C (32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE c UL us

ECONO-BEAM DC Hookup Diagrams

DC Sensors



SE61E Emitters

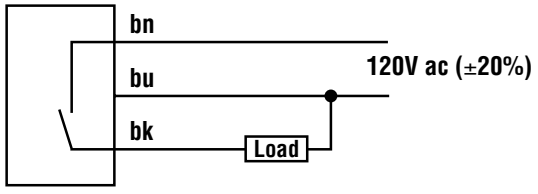


ECONO-BEAM AC Specifications

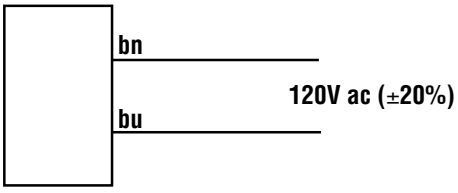
Supply Voltage and Current	120V ac (±20%, 50-60 Hz)
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	Solid-state (FET). SE61AW1 models are normally open (light operate): SE61RW1 models are normally closed (dark operate).
Output Rating	Maximum steady-state load capability 300 mA to 50°C ambient (122°F) **Inrush capability** 1 amp for 20 milliseconds (non repetitive) **Off-state leakage current** less than 50 µA rms **On-state voltage** drop ≤3 volts at 300 mA load, ≤2 volts at 15 mA load
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	**Opposed Mode:** 10 milliseconds on and 5 milliseconds off; independent of signal strength; **All other modes:** 10 milliseconds on and 10 milliseconds off Response time specification of load should be considered when important. (NOTE: 20 millisecond delay on power-up.)
Repeatability	**Opposed mode receiver:** 1 millisecond; **All other modes:** 2.3 milliseconds; independent of signal strength
Indicators	Red indicator LED on top of unit is "on" whenever the sensor is seeing its modulated light source (all except emitters)
Construction	Reinforced thermoplastic polyester housing, totally encapsulated and acrylic lenses
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12, and 13; IEC IP66
Connections	PVC-jacketed 3-wire 2 m (6.5') or 9 m (30') cables
Operating Conditions	**Temperature:** 0° to 50°C (32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE cULus

ECONO-BEAM AC Hookup Diagrams

AC Sensors

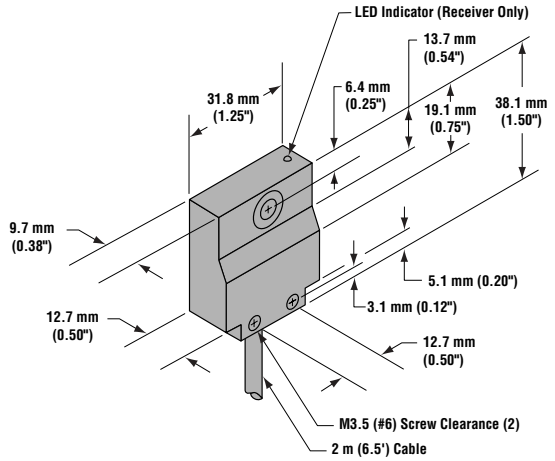


SE611E Emitters

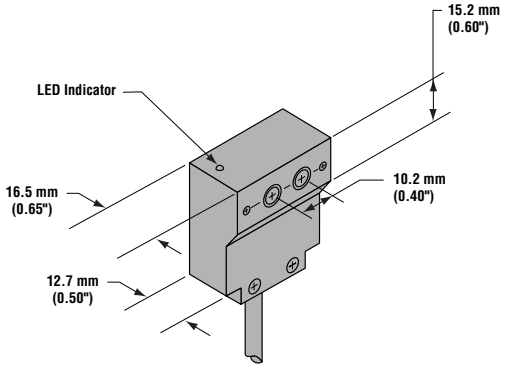


ECONO-BEAM Dimensions

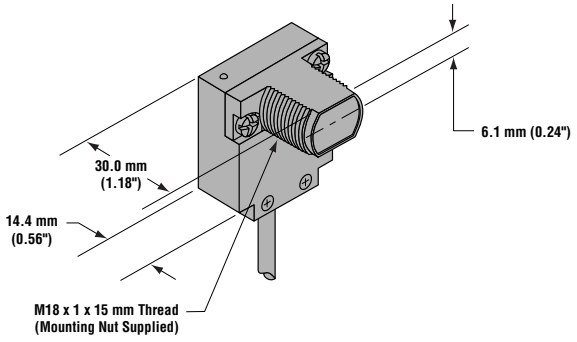
ECONO-BEAM DC Sensor - Opposed Mode (model suffix E & R)



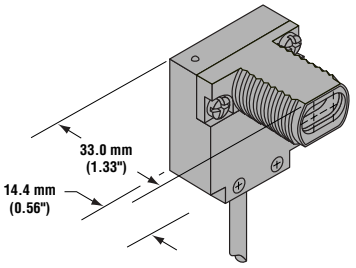
ECONO-BEAM DC Sensor - Diffuse & Divergent Mode (model suffix D & W)



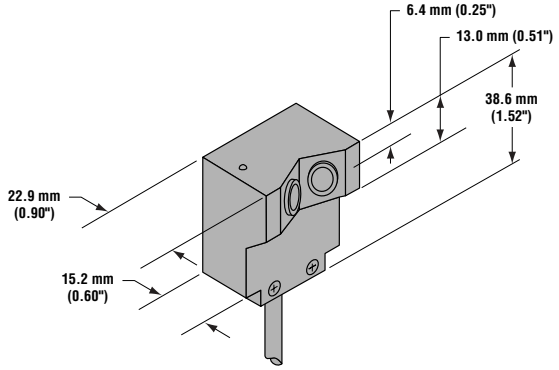
ECONO-BEAM AC or DC Retro Sensor & DC Convergent Mode (model suffix LV & CV)



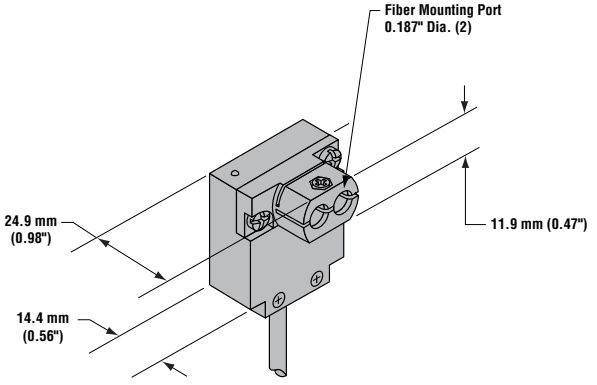
ECONO-BEAM DC Sensor - Glass Fiber Optic (model suffix F)



ECONO-BEAM DC Sensor - Mech. Convergent Mode (model suffix C)

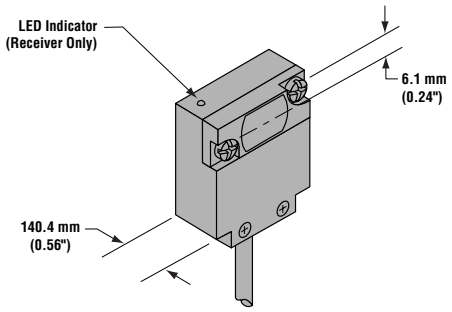


ECONO-BEAM DC Sensor - Plastic Fiber Optic (model suffix FP)



ECONO-BEAM Dimensions

ECONO-BEAM AC Sensor - Opposed & Diffuse Mode (model suffix E, R & D)



ECONO-BEAM Accessories

Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All ECONO-BEAM sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	**SE61RNC W/30**
MHS	Modified for High Speed	Standard dc ECONO-BEAM sensors with 10 millisecond output response may be modified for 1 millisecond response. NOTE: Faster response comes at the expense of lower excess gain.	**SE61RNCMHS**

Extension Cables (without connectors)

The following cables are available for extending the length of existing sensor cable. These are 30 m (100') lengths of ECONO-BEAM cable. This cable may be spliced to existing cable. Connectors, if used, must be customer-supplied.

Model	Type	Used with:
EC312A-100	2-conductor	All emitters
EC312-100	4-conductor	DC models (except emitters)
EC900A-100	3-conductor	AC models (except emitters)

NOTES:

M12 Laser Sensors

CAUTION . . .

Never stare directly into the emitter lens. Laser light can damage your eyes. Avoid placing any mirror-like object in the beam. Never use a mirror as a target.

M12 Laser sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

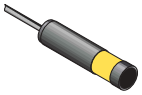
M12 Laser Emitters

For Use with Banner Modulated Receivers

CAUTION . . .

Never stare directly into the emitter lens. Laser light can damage your eyes. Avoid placing any mirror-like object in the beam. Never use a mirror as a target.

- M12 laser is a low-power device emitting a visible red beam (670 nm wavelength)
- Beam is bore-sighted to within 2 milliradians and 0.25 mm of the housing centerline
- Collimated, apertured beam is 2 mm diameter with divergence of less than 1 milliradian
- Compatible with a variety of Banner modulated photoelectric receivers (see Excess Gain chart, page 171)
- Useful for medium-range sensing, or for sensing very small objects or profiles; excellent mechanical repeatability in position-sensing applications
- Smooth-barrel aluminum housing is suitable for a precision mount
- Available with unterminated, 2 m (6.5') cable or 150 mm (6") pigtail, quick-disconnect cable
- Modulated beam (33kHz, 25% duty cycle)
- 57 mm (2.25") long overall
- 10 to 30V dc operation



M12 Class 1* (IEC) Models

Models	Range	Cable	Supply Voltage	Excess Gain	Effective Beam at Receiver	
					Opposed Distance	Beam Width
M126E1LD	Range varies, depending on which receiver is used (see Excess Gain chart, page 171).	2m (6.5') Unterminated	10-30V dc	See chart on page 171.	at 25ºC	
M126E1LDQ		150 mm (6") Pigtail with 3-pin Pico-style QD connector			1.5 m (5') 3 m (10') 6 m (20') 15 m (50') 30 m (100')	3.5 mm (0.14") 5.5 mm (0.2") 8.5 mm (0.3") 18 mm (0.7") 32 mm (1.3")

M12 Class 2* Models

Models	Range	Cable**	Supply Voltage	Excess Gain	Effective Beam at Receiver	
					Opposed Distance	Beam Width
M126E2LD	Range varies, depending on which receiver is used (see Excess Gain chart, page 171).	2m (6.5') Unterminated	10-30V dc	See chart on page 171.	at 25ºC	
M126E2LDQ		150 mm (6") Pigtail with 3-pin Pico-style QD connector			1.5 m (5') 3 m (10') 6 m (20') 15 m (50') 30 m (100')	3.5 mm (0.14") 5.5 mm (0.2") 8.5 mm (0.3") 18 mm (0.7") 32 mm (1.3")

* • See M12 Specifications for complete information regarding classification

** • 9 m (30') cables are available by adding suffix **"W/30"** to the model number to the cabled version (e.g., **M126E1LD W/30**).

• A model with a QD connector requires an accessory mating cable. See page 173 and the Accessories section for more information.

Excess Gain

Excess Gain of the M12 emitter is dependent on the particular receiver used. Following is a comparison of the excess gain for various recommended receivers at 15 m (50').

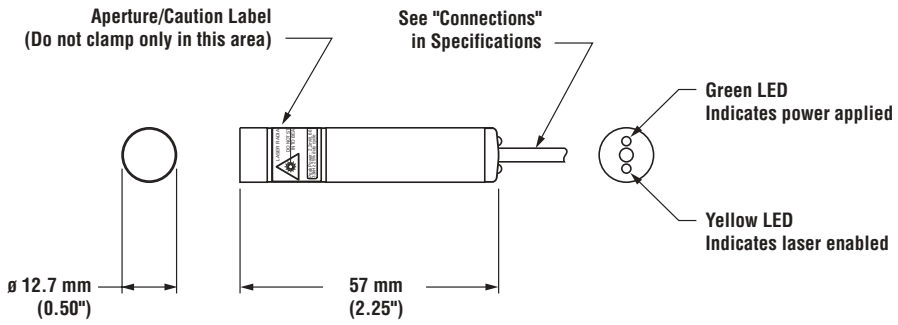
Receiver	Class 1* (IEC) Excess Gain at 15 m (50')	Class 2* Excess Gain at 15 m (50')
MULTI-BEAM		
SBRX1	1,900	19,000
SBR1	1,900	19,000
SBRXD1	1,900	19,000
SBRD1	1,900	19,000
MAXI-BEAM		
RSBR	1,400	14,000
RSBRSR	150	1,500
VALU-BEAM		
SMW95R	3,400	34,000
SMI91RQD	1,800	18,000
EZ-BEAM		
T18SN6R	750	7,500
T30SN6R	750	7,500
S12SN6R	750	7,500

Receiver	Class 1* (IEC) Excess Gain at 15 m (50')	Class 2* Excess Gain at 15 m (50')
MINI-BEAM		
SM31R	250	2,500
SM31RL	1,700	17,000
SM31RMHS	180	1,800
SM31RLMHS	1,100	11,000
ECONO-BEAM		
SE61R	60	600
SE61RMHS	50	500
Others		
SM51RB	120	1,200
Q23SN6R	40	400
Q10AN6R	25	250
Q45BB6R	900	9,000

For information on compatibility of the M12 emitter with other Banner photoelectric receivers contact the factory Applications Group at the address or numbers listed on the back cover.

* See M12 Specifications for complete information regarding classification

M12 Dimensions

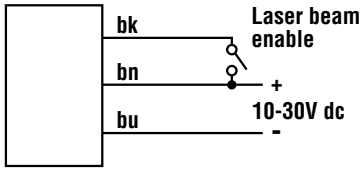


M12 Specifications

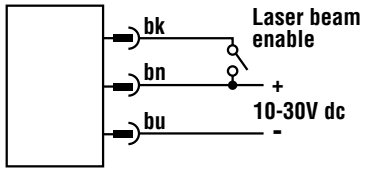
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 30 mA
Supply Protection Circuitry	Protected against electrostatic discharge (ESD) and transient voltages; Protected against reverse polarity
Delay at Power-up	**M126E1 models:** less than 100 milliseconds **M126E2 models:** less than 30 milliseconds
Sensing Beam	670 nm visible red laser (temperature coefficient 0.2 nm/°C); **Pulse Width:** 7µs **Rep Rate:** 30µs **Peak Output Power:** **M126E1 models:** 0.36 milliwatts **M126E2 models:** 2.8 milliwatts
Beam Diameter at Aperture	Approximately 2 mm (0.08") diameter
Beam Divergence	±0.5 milliradians typical at 25°C; ±1.0 milliradian at operating temperature extremes
Beam Placement	Within 0.25 mm (0.01") and ±2 milliradians of mechanical centerline axis of housing
Laser Control	Apply +10 to 30V dc to black wire to enable beam; Inhibit beam by applying 0V dc or by opening circuit; Enable delay: **M126E1 models:** less than 100 milliseconds **M126E2 models:** less than 30 milliseconds Inhibit delay less than 1 millisecond
Indicators	Indicators are visible through rear cover. Green indicates power applied Yellow indicates laser enabled
Construction	12.7 mm (0.50") diameter smooth aluminum barrel; Black hard-coat anodized finish, MIL-A-8625 Type III, Class II
Environmental Rating	NEMA 6; IEC IP67
Connections	PVC-jacketed 3-conductor 2 m (6.5') or 9 m (30') high-flex cable (unterminated); or 150 mm (6") pigtail with 3-wire Pico-style connector
Operating Conditions	**Temperature:** 0° to 40°C (32° to 104°F) **Maximum relative humidity:** 90% at 40° C (non-condensing)
Laser Classification	**M126E1 models:** Class 2 (CDRH), US Safety Standards 21 CFR 1040.10; Class 1 (IEC), European Standards EN 60825-1 and IEC 60825-1 **M126E2 models:** Class 2 (CDRH), US Safety Standards 21 CFR 1040.10; Class 2 (IEC), European Standards EN 60825-1 and IEC 60825-1
Certifications	CE

M12 Hookup Diagrams

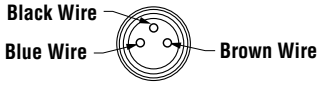
M12 Laser Diode Emitter Unterminated Cable



M12 Laser Diode Emitter 3-pin Pico-style Connector



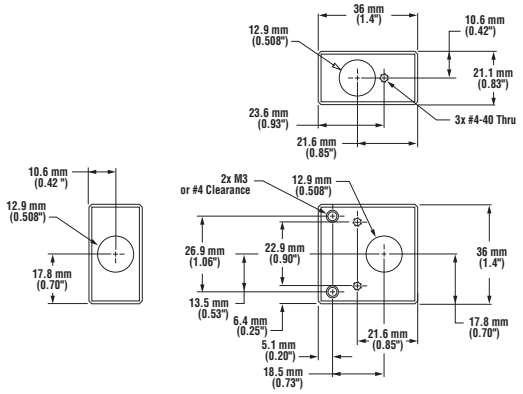
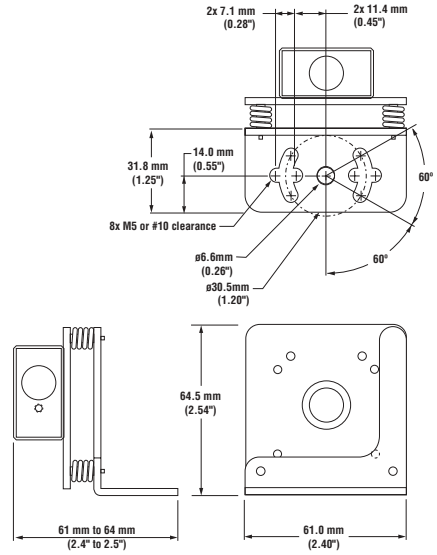
3-Pin Pico-Style Pin-out



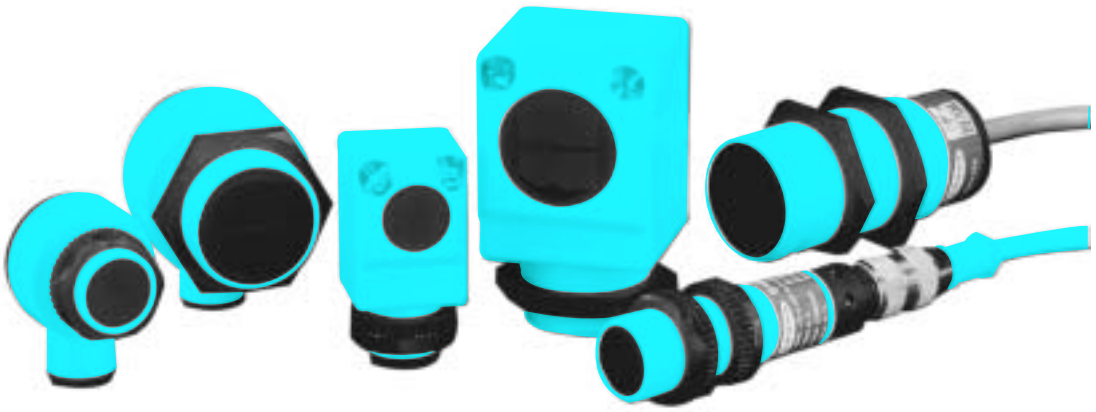
Quick-Disconnect (QD) Cables

Style	Model	Length	Connector	For use with
3-Pin Pico	**PKG3-2**	2 m (6.5')	Straight	M12 Class 1 and 2 Laser sensors

Mounting Brackets

Model	Description	Dimensions
SMB127 **Mounting Block** 	• Mounting block • Comes with: 3/64" hex wrench and 4 set screws	
SMB46X3 	• Assembly with mounting block and adjustable bracket • Includes: - 2 mm hex key - 3/64" hex wrench and 4 set screws	

NOTES:



EZ-BEAM® Sensors

Exceptions noted

Exceptions noted

EZ-BEAM sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

S12 Series Sensors

S12 Emitter and Receiver Shown

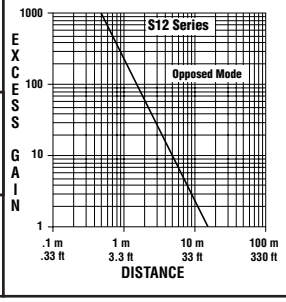
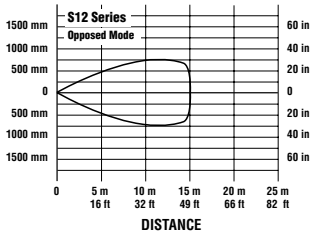
- 12 mm thermoplastic polyester threaded barrel sensor
- 10 to 30V dc; choose SPDT (complementary) NPN or PNP outputs (100 mA max. ea.)

S12 Sensing Mode Options

Opposed

Visible red, 680 nm

S12 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
S126E **S126EQP**	15 m (50')	2 m (6.5') 4-Pin Pico QD	10-30V dc	—		Effective Beam: 8.1 mm 
S12SN6R **S12SN6RQP**		2 m (6.5') 4-Pin Pico QD		NPN		
S12SP6R **S12SP6RQP**		2 m (6.5') 4-Pin Pico QD		PNP		

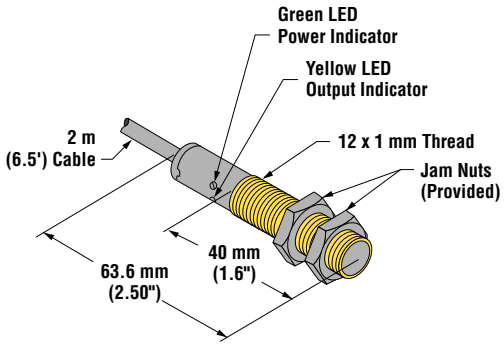
For EZ-BEAM S12 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **S12SN6R W/30**)

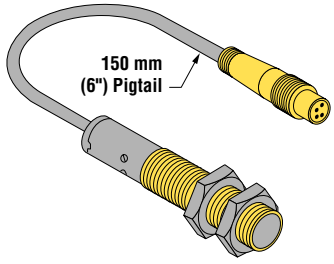
ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.

S12 Dimensions

S12 DC Sensor

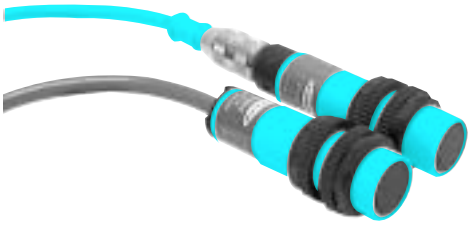


S12 DC Sensor with Pico-Style QD



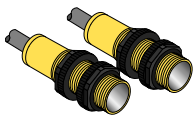
S18 Series Sensors

S18 quick-disconnect (top) and cabled (bottom) versions shown



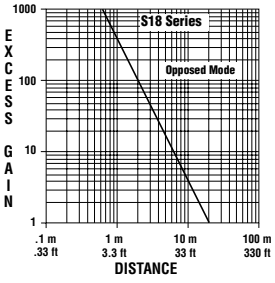
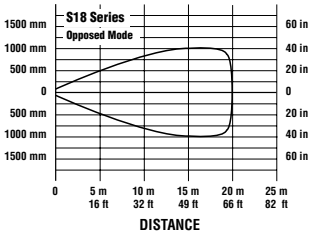
- 18 mm thermoplastic polyester threaded barrel sensor
- Advanced self-diagnostics with separate alarm output†; dual LED system indicates sensor performance
- Choice of integral cable or euro-style quick-disconnect connector
- 10 to 30V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA max. ea.)
- 20 to 250V ac (3-wire hookup); SPST solid-state switch output, maximum load 300 mA

S18 Sensing Mode Options

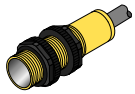


Infrared, 950 nm

S18 Opposed Mode Emitter (E) and Receiver (R)

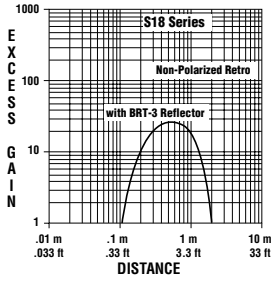
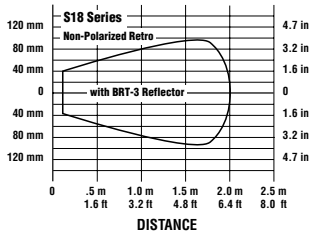
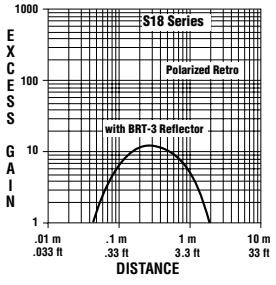
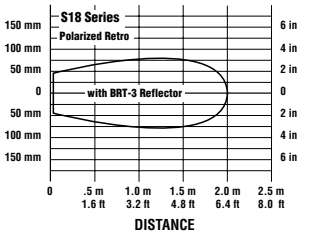
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
S186E **S186EQ**	20 m (66')	2 m (6.5') 4-Pin Euro QD	10-30V dc	—		Effective Beam: 13 mm 
S18SN6R **S18SN6RQ**		2 m (6.5') 4-Pin Euro QD		NPN		
S18SP6R **S18SP6RQ**		2 m (6.5') 4-Pin Euro QD		PNP		
S183E **S183EQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	—		
S18AW3R **S18AW3RQ1**		2 m (6.5') 4-Pin Micro QD		LO		
S18RW3R **S18RW3RQ1**		2 m (6.5') 4-Pin Micro QD		DO		

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



Non-Polarized, Polarized

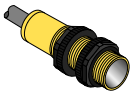
S18 Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized (Infrared, 950 nm)						
S18SN6L **S18SN6LQ**	2 m (79")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
S18SP6L **S18SP6LQ**		2 m (6.5') 4-Pin Euro QD		PNP		
S18AW3L **S18AW3LQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
S18RW3L **S18RW3LQ1**		2 m (6.5') 4-Pin Micro QD		DO		
Polarized (Visible red, 680 nm)						
S18SN6LP **S18SN6LPQ**	2 m (79")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
S18SP6LP **S18SP6LPQ**		2 m (6.5') 4-Pin Euro QD		PNP		
S18AW3LP **S18AW3LPQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
S18RW3LP **S18RW3LPQ1**		2 m (6.5') 4-Pin Micro QD		DO		

For EZ-BEAM S18 Series Sensors:

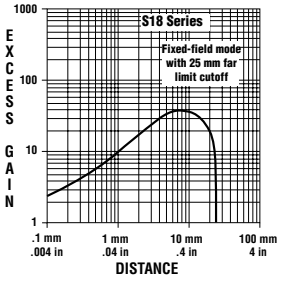
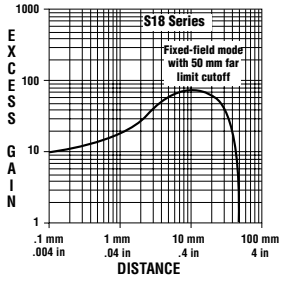
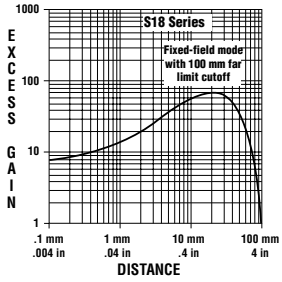
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **S18RW3L W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.



Infrared, 880 nm

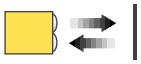
S18 Fixed-Field Mode

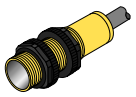
Models	Cutoff Point	Cable	Supply Voltage	Output Type	Excess Gain (Performance based on 90% reflectance white test card)
With 25 mm Far Limit Cutoff					
S18SN6FF25 **S18SN6FF25Q**	25 mm (1")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
S18SP6FF25 **S18SP6FF25Q**		2 m (6.5') 4-Pin Euro QD		PNP	
S18AW3FF25 **S18AW3FF25Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
S18RW3FF25 **S18RW3FF25Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 50 mm Far Limit Cutoff					
S18SN6FF50 **S18SN6FF50Q**	50 mm (2")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
S18SP6FF50 **S18SP6FF50Q**		2 m (6.5') 4-Pin Euro QD		PNP	
S18AW3FF50 **S18AW3FF50Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
S18RW3FF50 **S18RW3FF50Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 100 mm Far Limit Cutoff					
S18SN6FF100 **S18SN6FF100Q**	100 mm (4")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
S18SP6FF100 **S18SP6FF100Q**		2 m (6.5') 4-Pin Euro QD		PNP	
S18AW3FF100 **S18AW3FF100Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
S18RW3FF100 **S18RW3FF100Q1**		2 m (6.5') 4-Pin Micro QD		DO	

For EZ-BEAM S18 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **S18RW3DL W/30**)

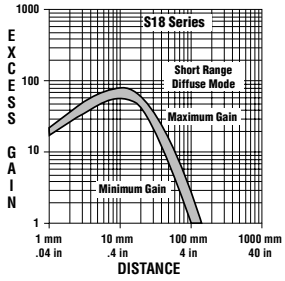
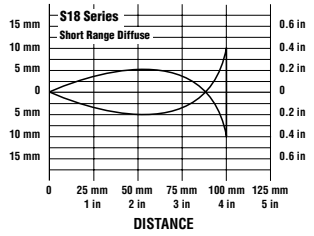
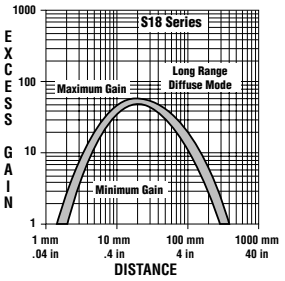
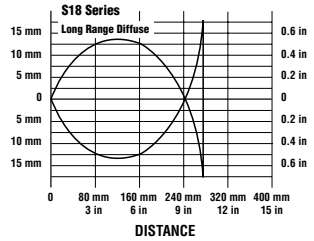
ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.





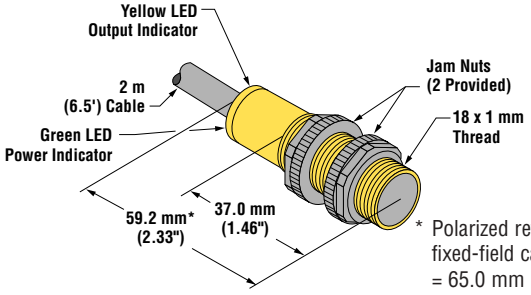
Infrared, 880 nm

S18 Diffuse Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
100 mm Range						
S18SN6D **S18SN6DQ**	100 mm (4")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
S18SP6D **S18SP6DQ**		2 m (6.5') 4-Pin Euro QD		PNP		
S18AW3D **S18AW3DQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
S18RW3D **S18RW3DQ1**		2 m (6.5') 4-Pin Micro QD		DO		
300 mm Range						
S18SN6DL **S18SN6DLQ**	300 mm (12")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
S18SP6DL **S18SP6DLQ**		2 m (6.5') 4-Pin Euro QD		PNP		
S18AW3DL **S18AW3DLQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
S18RW3DL **S18RW3DLQ1**		2 m (6.5') 4-Pin Micro QD		DO		

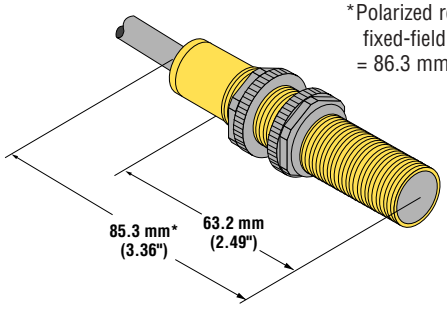
S18 Dimensions

S18 DC Sensor



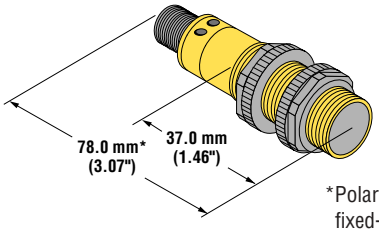
* Polarized retroreflective and fixed-field cabled models = 65.0 mm (2.56")

S18 AC Sensor



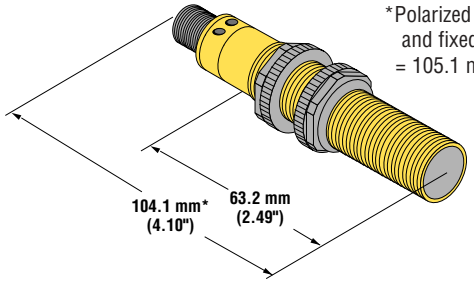
*Polarized retroreflective and fixed-field cabled models = 86.3 mm (3.40")

S18 DC Sensor with Euro-Style QD



*Polarized retroreflective and fixed-field QD models = 83.8 mm (3.30")

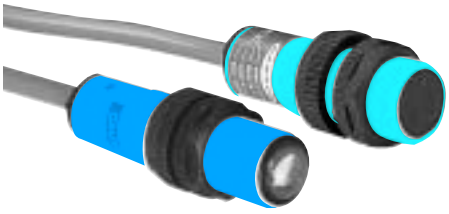
S18 AC Sensor with Micro-Style QD



*Polarized retroreflective and fixed-field QD models = 105.1 mm (4.14")

S186ELD Laser Diode Emitters

S186ELD Laser Emitter with EZ-BEAM S18 Receiver



CAUTION . . .

Never stare directly into the emitter lens. Laser light can damage your eyes. Avoid placing any mirror-like object in the beam. Never use a mirror as a target.

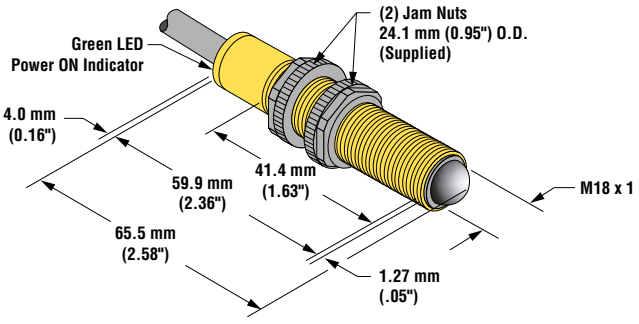
- Self-contained Class 2 modulated visible laser diode emitters permit higher gain and extended range in opposed mode sensing systems
- Advanced self-diagnostics with separate alarm output†; dual LED system indicates sensor performance
- Choice of integral cable or euro-style quick-disconnect connector
- Narrow effective beam for small-object detection or for precise position control
- 10 to 30V dc operation; third wire extinguishes laser light when connected to +V dc
- Compatible with all EZ-BEAM receivers; may also be used with a variety of other Banner modulated photoelectric receivers (see Excess Gain chart on page 183)
- Popular 18 mm threaded barrel design

S186ELD Laser Diode Emitter

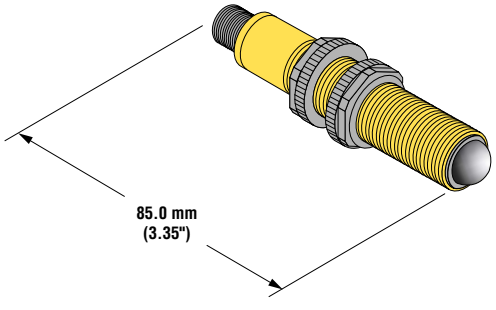
Models	Range	Cable	Excess Gain	Effective Beam at Receiver	
				Opposed Distance	Beam Width
S186ELD **S186ELDQ**	Range varies depending on which receiver is used	2 m (6.5') 4-Pin Euro QD	See chart on page 183 and/or contact factory Application Engineering group for range and excess gain information	1.5 m 3 m 6 m 15 m 30 m	4 mm 5.5 mm 8.5 mm 18 mm 32 mm

S186ELD Laser Diode Emitter Dimensions

S186ELD Laser Diode Emitter



S186ELDQ Laser Diode Emitter



For S186ELD Laser Diode Emitters:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **S186ELD W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.

S186ELD Laser Diode Emitter Specifications

Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 35 mA
Supply Protection Circuitry	Protected against reverse polarity
Delay at Power-up	1.5 seconds
Sensing Beam	670 nm visible red Class 2 laser (temperature coefficient 0.2 nm/°C) **Pulse Width:** 7µs **Rep Rate:** 30µs **Peak Output Power:** less than 1 milliwatt
Beam Diameter at Aperture	2.5 mm (0.10") collimated ellipse
Beam Divergence	±0.5 milliradians typical
Laser Control	Enable beam by applying 0V dc or by opening circuit; apply +10 to 30V dc to black wire to inhibit beam
Indicators	Green indicator, visible through rear cover, indicates power applied
Construction	M18 x 1 threaded yellow thermoplastic polyester barrel housing. Acrylic lens. Electronics totally encapsulated. Two mounting nuts are included.
Environmental Rating	NEMA 6P; IEC IP67
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') attached cable, or 4-pin Euro-style quick-disconnect (QD) fitting.
Operating Conditions	**Temperature:** -10° to +50°C (+14° to 122°F) **Maximum relative humidity:** 90% at 50° C (non-condensing)
Laser Classification	US Safety Standards 21 CFR 1040.10 and 1040.11; European Standards EN 60825 and IEC 60825
Certifications	CE ETL LISTED

Excess Gain

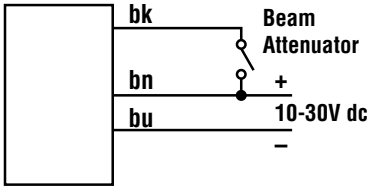
Excess Gain of the S186ELD emitter is dependent on the particular receiver used. Following is a comparison of the excess gain for various recommended receivers at 15 m (50').

Receiver	Excess Gain at 15 m (50')
MULTI-BEAM	
SBRX1	3,000
SBR1	3,000
SBRXD1	3,000
SBRD1	3,000
MAXI-BEAM	
RSBR	750
RSBRSR	120
VALU-BEAM	
SMW95R	5,000
SMI91RQD	3,000
EZ-BEAM	
T18SN6R	400
T30SN6R	400
S12SN6R	400

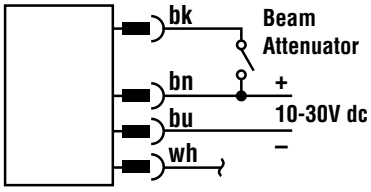
Receiver	Excess Gain at 15 m (50')
MINI-BEAM	
SM31R	300
SM31RL	1,700
SM31RMHS	200
SM31RLMHS	1,100
ECONO-BEAM	
SE61R	45
SE61RMHS	40
Others	
SM51RB	140
Q23SN6R	25
Q10AN6R	20
Q45BB6R	1,500

S186ELD Laser Diode Emitter Hookup Diagrams

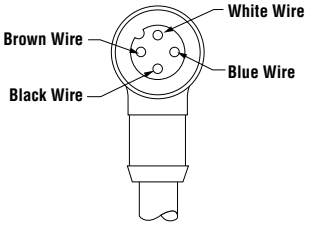
S186ELD Laser Diode Emitter

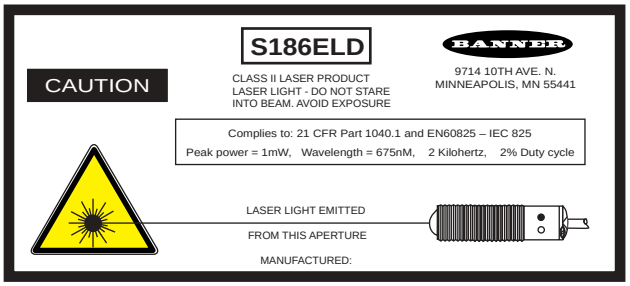


S186ELDQ Laser Diode Emitter 4-Pin Euro-Style



4-Pin Euro-Style Pin-out (Cable Connector Shown)





Quick-Disconnect (QD) Option

S186ELDQ Laser Diode Emitters are sold either with a 2 m (6.5') or 9 m (30') attached PVC-covered cable or with a 4-pin euro-style QD cable fitting.

DC QD sensors are identified by the letter “Q” in their model number suffix. Mating cables for QD S186ELDQ sensors are model MQDC-415 (straight connector) or MQDC-415RA (right-angled connector). Cables are supplied in a standard length of 5 m (15'). For more information on QD cable, see page 232 and the Accessories section.

NOTES:

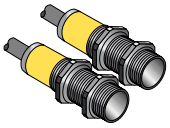
M18 Series Stainless Steel Sensors

EZ-BEAM M18 cabled and quick-disconnect versions

- 18 mm stainless steel threaded barrel sensor
- 10 to 30V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA max. ea.)
- Advanced self-diagnostics with separate alarm output†; dual LED system indicates sensor performance
- Choice of integral cable or euro-style quick-disconnect connector

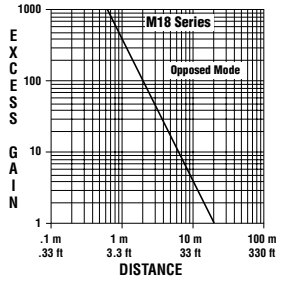
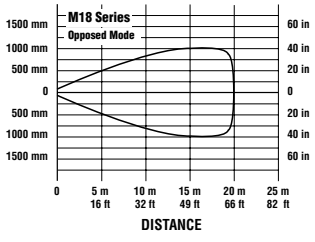
† U.S. patent 5087838

M18 Sensing Mode Options



Infrared, 950 nm

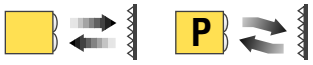
M18 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
M186E **M186EQ**	20 m (66')	2 m (6.5') 4-Pin Euro QD	10-30V dc	—		Effective Beam: 13 mm 
M18SN6R **M18SN6RQ**		2 m (6.5') 4-Pin Euro QD		NPN		
M18SP6R **M18SP6RQ**		2 m (6.5') 4-Pin Euro QD		PNP		

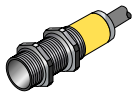
For EZ-BEAM M18 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **M18SN6R W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 232 and Accessories section for more information

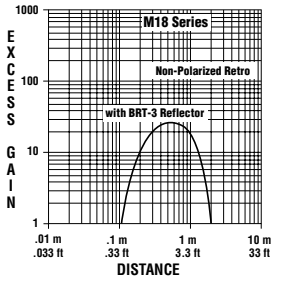
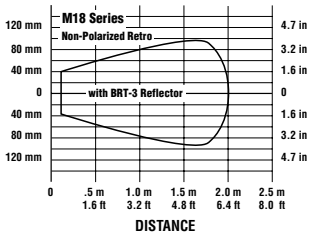
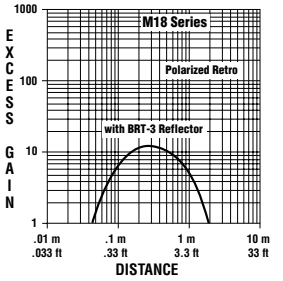
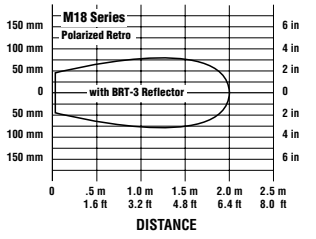


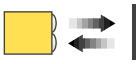
NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



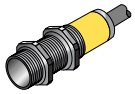
Non-Polarized, Polarized

M18 Retroreflective Mode

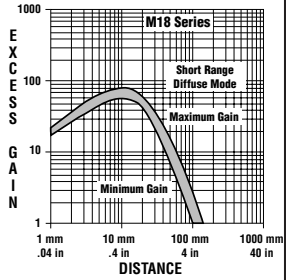
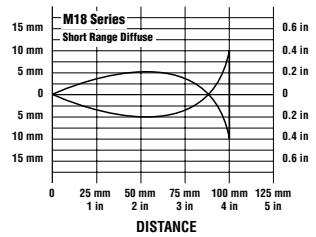
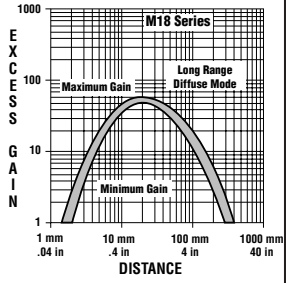
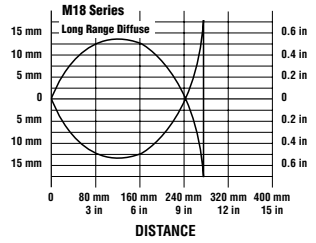
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized (Infrared, 950 nm)						
M18SN6L **M18SN6LQ**	2 m (79")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
M18SP6L **M18SP6LQ**		2 m (6.5') 4-Pin Euro QD		PNP		
Polarized (Visible red, 680 nm)						
M18SN6LP **M18SN6LPQ**	2 m (79")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
M18SP6LP **M18SP6LPQ**		2 m (6.5') 4-Pin Euro QD		PNP		

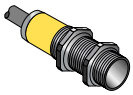


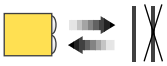
Infrared, 880 nm



M18 Diffuse Mode

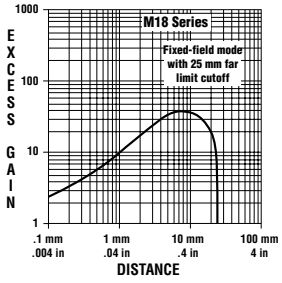
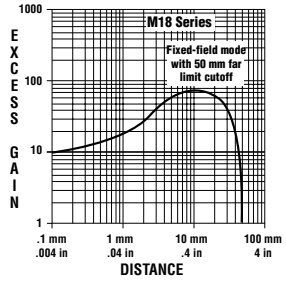
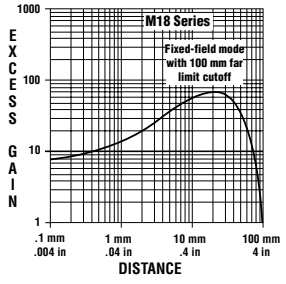
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
100 mm Range						
M18SN6D **M18SN6DQ**	100 mm (4")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
M18SP6D **M18SP6DQ**		2 m (6.5') 4-Pin Euro QD		PNP		
300 mm Range						
M18SN6DL **M18SN6DLQ**	300 mm (12")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
M18SP6DL **M18SP6DLQ**		2 m (6.5') 4-Pin Euro QD		PNP		





Infrared, 880 nm

M18 Fixed-Field Mode

Models	Cutoff Point	Cable	Supply Voltage	Output Type	Excess Gain (Performance based on 90% reflectance white test card)
With 25 mm Far Limit Cutoff					
M18SN6FF25 **M18SN6FF25Q**	25 mm (1")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
M18SP6FF25 **M18SP6FF25Q**		2 m (6.5') 4-Pin Euro QD		PNP	
With 50 mm Far Limit Cutoff					
M18SN6FF50 **M18SN6FF50Q**	50 mm (2")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
M18SP6FF50 **M18SP6FF50Q**		2 m (6.5') 4-Pin Euro QD		PNP	
With 100 mm Far Limit Cutoff					
M18SN6FF100 **M18SN6FF100Q**	100 mm (4")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
M18SP6FF100 **M18SP6FF100Q**		2 m (6.5') 4-Pin Euro QD		PNP	

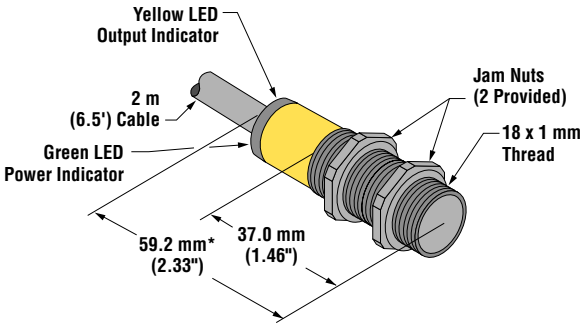
For EZ-BEAM M18 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **M18SN6FF50 W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 232 and Accessories section for more information

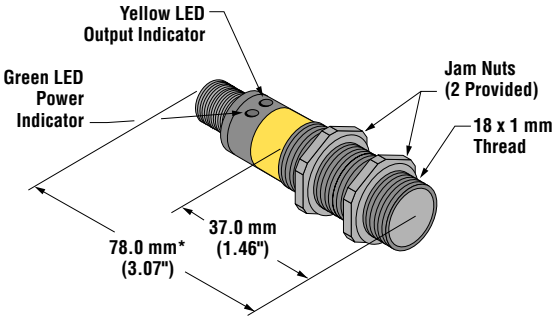
M18 Dimensions

M18 with Attached Cable



*Polarized retroreflective and fixed-field cabled models = 65.0 mm (2.56")

M18 with QD Cable



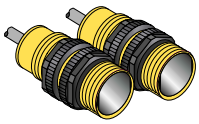
*Polarized retroreflective and fixed-field QD models = 83.8 mm (3.30")

S30 Series Sensors

S30 quick-disconnect (top) and cabled (bottom) versions shown

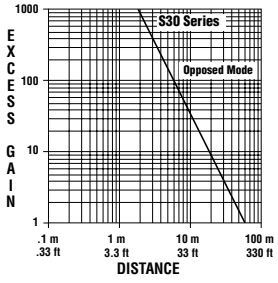
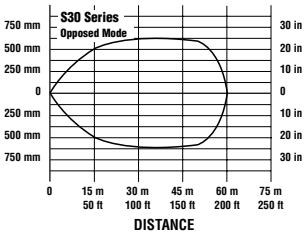
- 30 mm thermoplastic polyester threaded barrel sensor
- Advanced self-diagnostics with separate alarm output†; dual LED system indicates sensor performance
- Choice of integral cable or euro-style quick-disconnect connector
- 10 to 30V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA max. ea.)
- 20 to 250V ac (3-wire hookup); SPST solid-state switch output, maximum load 300 mA

S30 Sensing Mode Options



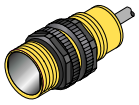
Infrared, 950 nm

S30 Opposed Mode Emitter (E) and Receiver (R)

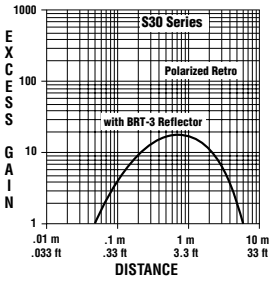
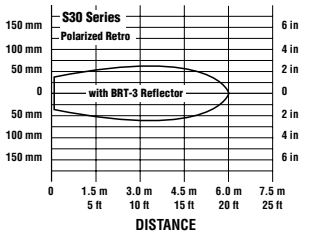
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
S306E **S306EQ**	60 m (200')	2 m (6.5') 4-Pin Euro QD	10-30V dc	—		Effective Beam: 23 mm 
S30SN6R **S30SN6RQ**		2 m (6.5') 4-Pin Euro QD		NPN		
S30SP6R **S30SP6RQ**		2 m (6.5') 4-Pin Euro QD		PNP		
S303E **S303EQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	—		
S30AW3R **S30AW3RQ1**		2 m (6.5') 4-Pin Micro QD		LO		
S30RW3R **S30RW3RQ1**		2 m (6.5') 4-Pin Micro QD		DO		

Visible red, 680 nm

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



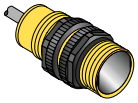
S30 Polarized Retroreflective Mode

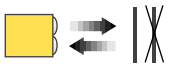
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
S30SN6LP **S30SN6LPQ**	6 m (20')	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
S30SP6LP **S30SP6LPQ**		2 m (6.5') 4-Pin Euro QD		PNP		
S30AW3LP **S30AW3LPQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
S30RW3LP **S30RW3LPQ1**		2 m (6.5') 4-Pin Micro QD		DO		

For EZ-BEAM S30 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **S30SN6R W/30**)

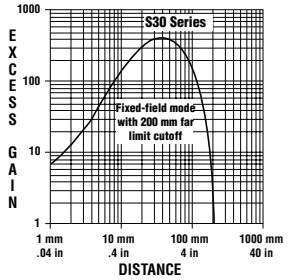
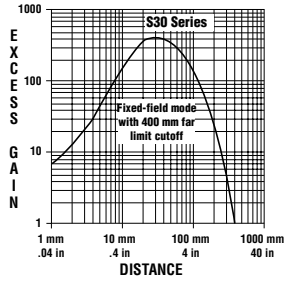
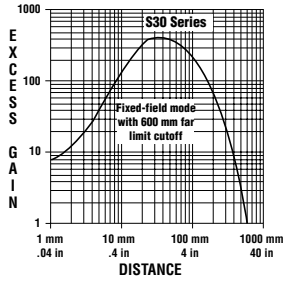
ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.





Infrared, 880 nm

S30 Fixed-Field Mode

Models	Cutoff Point	Cable	Supply Voltage	Output Type	Excess Gain Performance based on 90% reflectance white test card
With 200 mm Far Limit Cutoff					
S30SN6FF200 **S30SN6FF200Q**	200 mm (8")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
S30SP6FF200 **S30SP6FF200Q**		2 m (6.5') 4-Pin Euro QD		PNP	
S30AW3FF200 **S30AW3FF200Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
S30RW3FF200 **S30RW3FF200Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 400 mm Far Limit Cutoff					
S30SN6FF400 **S30SN6FF400Q**	400 mm (16")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
S30SP6FF400 **S30SP6FF400Q**		2 m (6.5') 4-Pin Euro QD		PNP	
S30AW3FF400 **S30AW3FF400Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
S30RW3FF400 **S30RW3FF400Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 600 mm Far Limit Cutoff					
S30SN6FF600 **S30SN6FF600Q**	600 mm (24")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
S30SP6FF600 **S30SP6FF600Q**		2 m (6.5') 4-Pin Euro QD		PNP	
S30AW3FF600 **S30AW3FF600Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
S30RW3FF600 **S30RW3FF600Q1**		2 m (6.5') 4-Pin Micro QD		DO	

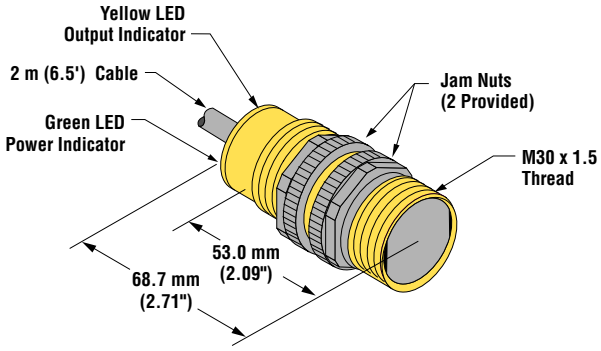
For EZ-BEAM S30 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **S30AW3FF600 W/30**)

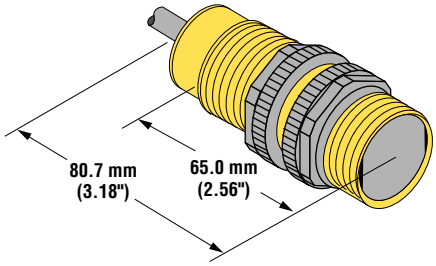
ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.

S30 Dimensions

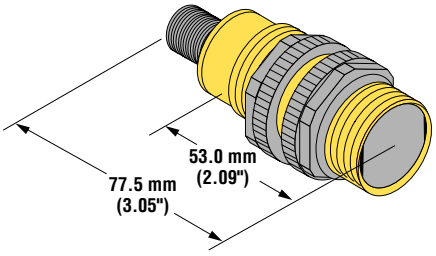
S30 DC Sensor



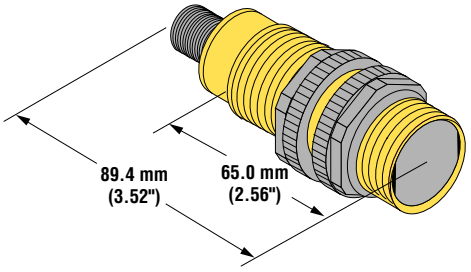
S30 AC Sensor



S30 DC Sensor with Euro-Style QD

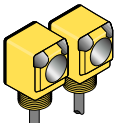


S30 AC Sensor with Micro-Style QD



Q25 Series Sensors

Q25 quick-disconnect with right-angle cable (left) and cabled (right) versions shown

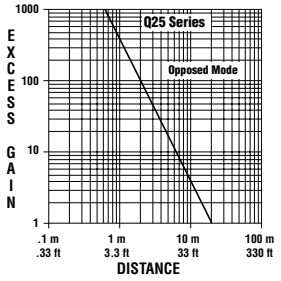
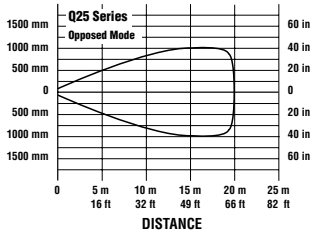


- Rectangular thermoplastic polyester housing
- Advanced self-diagnostics with separate alarm output†; dual LED system indicates sensor performance
- Choice of integral cable or euro-style quick-disconnect connector
- 10 to 30V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA max. ea.)
- 20 to 250V ac (3-wire hookup); SPST solid-state switch output, maximum load 300 mA

Q25 Sensing Mode Options

Infrared, 950 nm

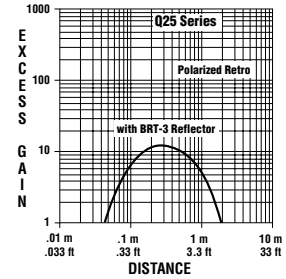
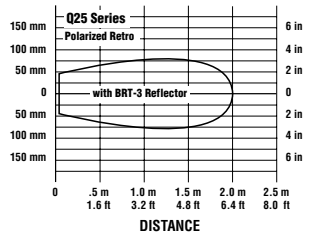
Q25 Opposed Mode Emitter (E) and Receiver (R)

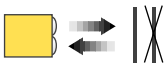
Models	Range	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q256E **Q256EQ**	20 m (66')	2 m (6.5') 4-Pin Euro QD	10-30V dc	—		Effective Beam: 13 mm 
Q25SN6R **Q25SN6RQ**		2 m (6.5') 4-Pin Euro QD		NPN		
Q25SP6R **Q25SP6RQ**		2 m (6.5') 4-Pin Euro QD		PNP		
Q253E **Q253EQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	—		
Q25AW3R **Q25AW3RQ1**		2 m (6.5') 4-Pin Micro QD		LO		
Q25RW3R **Q25RW3RQ1**		2 m (6.5') 4-Pin Micro QD		DO		

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

Visible red, 680 nm

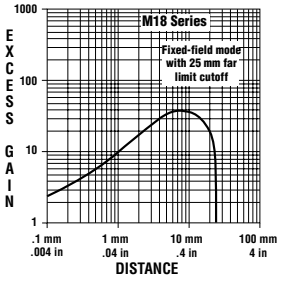
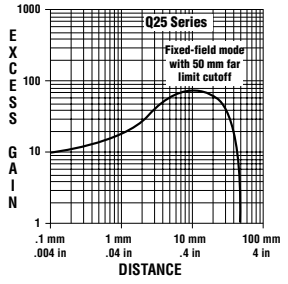
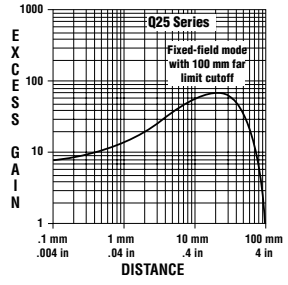
Q25 Polarized Retroreflective Mode

Models	Range	Cable*	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q25SN6LP **Q25SN6LPQ**	2 m (79")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
Q25SP6LP **Q25SP6LPQ**		2 m (6.5') 4-Pin Euro QD		PNP		
Q25AW3LP **Q25AW3LPQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
Q25RW3LP **Q25RW3LPQ1**		2 m (6.5') 4-Pin Micro QD		DO		



Infrared, 880 nm

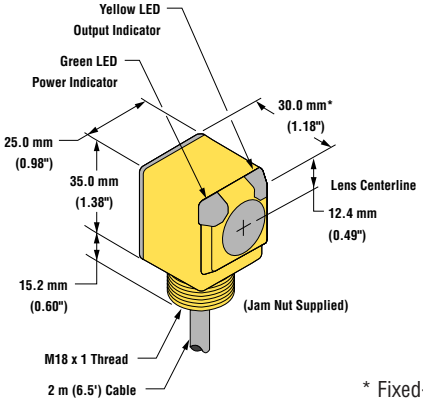
Q25 Fixed-Field Mode

Models	Cutoff Point	Cable*	Supply Voltage	Output Type	Excess Gain
					Performance based on 90% reflectance white test card
With 25 mm Far Limit Cutoff					
Q25SN6FF25 **Q25SN6FF25Q**	25 mm (1")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
Q25SP6FF25 **Q25SP6FF25Q**		2 m (6.5') 4-Pin Euro QD		PNP	
Q25AW3FF25 **Q25AW3FF25Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
Q25RW3FF25 **Q25RW3FF25Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 50 mm Far Limit Cutoff					
Q25SN6FF50 **Q25SN6FF50Q**	50 mm (2")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
Q25SP6FF50 **Q25SP6FF50Q**		2 m (6.5') 4-Pin Euro QD		PNP	
Q25AW3FF50 **Q25AW3FF50Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
Q25RW3FF50 **Q25RW3FF50Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 100 mm Far Limit Cutoff					
Q25SN6FF100 **Q25SN6FF100Q**	100 mm (4")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
Q25SP6FF100 **Q25SP6FF100Q**		2 m (6.5') 4-Pin Euro QD		PNP	
Q25AW3FF100 **Q25AW3FF100Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
Q25RW3FF100 **Q25RW3FF100Q1**		2 m (6.5') 4-Pin Micro QD		DO	

* 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q25SN6R W/30**)
A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.

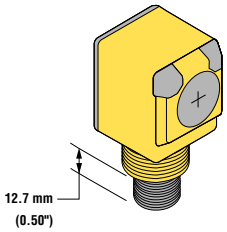
Q25 Dimensions

Q25 Sensor - All Cabled Models



Q25 Sensor - All Quick-Disconnect Models

DC Sensors with Euro-Style QD
AC Sensors with Micro-Style QD



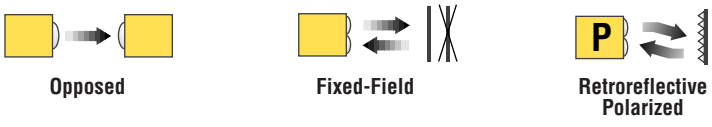
* Fixed-field models = 31.0 mm (1.22")

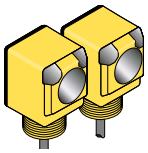
Q40 Series Sensors

Q40 quick-disconnect with right-angle cable (left) and cabled (right) versions shown

- Rectangular thermoplastic polyester housing
- Advanced self-diagnostics with separate alarm output†; dual LED system indicates sensor performance
- Choice of integral cable or euro-style quick-disconnect connector
- 10 to 30V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA max. ea.)
- 20 to 250V ac (3-wire hookup); SPST solid-state switch output, maximum load 300 mA

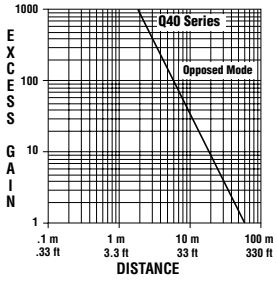
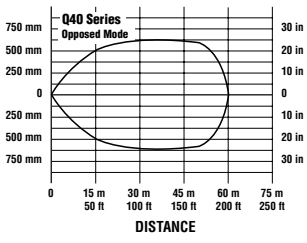
Q40 Sensing Mode Options

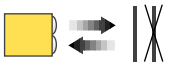




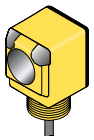
Infrared, 950 nm

Q40 Opposed Mode Emitter (E) and Receiver (R)

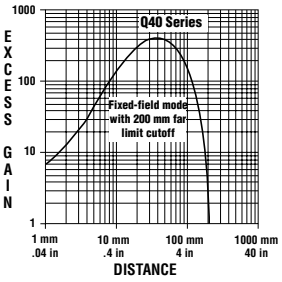
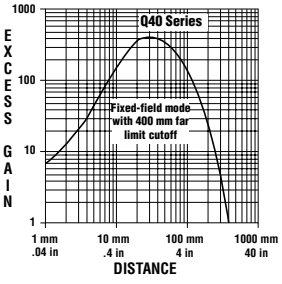
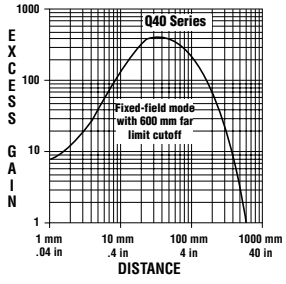
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q406E **Q406EQ**	60 m (200')	2 m (6.5') 4-Pin Euro QD	10-30V dc	—		Effective Beam: 23 mm 
Q40SN6R **Q40SN6RQ**		2 m (6.5') 4-Pin Euro QD		NPN		
Q40SP6R **Q40SP6RQ**		2 m (6.5') 4-Pin Euro QD		PNP		
Q403E **Q403EQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	—		
Q40AW3R **Q40AW3RQ1**		2 m (6.5') 4-Pin Micro QD		LO		
Q40RW3R **Q40RW3RQ1**		2 m (6.5') 4-Pin Micro QD		DO		



Infrared, 880 nm



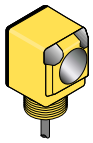
Q40 Fixed-Field Mode

Models	Cutoff Point	Cable	Supply Voltage	Output Type	Excess Gain Performance based on 90% reflectance white test card
With 200 mm Far Limit Cutoff					
Q40SN6FF200 **Q40SN6FF200Q**	200 mm (8")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
Q40SP6FF200 **Q40SP6FF200Q**		2 m (6.5') 4-Pin Euro QD		PNP	
Q40AW3FF200 **Q40AW3FF200Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
Q40RW3FF200 **Q40RW3FF200Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 400 mm Far Limit Cutoff					
Q40SN6FF400 **Q40SN6FF400Q**	400 mm (16")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
Q40SP6FF400 **Q40SP6FF400Q**		2 m (6.5') 4-Pin Euro QD		PNP	
Q40AW3FF400 **Q40AW3FF400Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
Q40RW3FF400 **Q40RW3FF400Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 600 mm Far Limit Cutoff					
Q40SN6FF600 **Q40SN6FF600Q**	600 mm (24")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
Q40SP6FF600 **Q40SP6FF600Q**		2 m (6.5') 4-Pin Euro QD		PNP	
Q40AW3FF600 **Q40AW3FF600Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
Q40RW3FF600 **Q40RW3FF600Q1**		2 m (6.5') 4-Pin Micro QD		DO	

For EZ-BEAM Q40 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q40RW3FF400 W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.

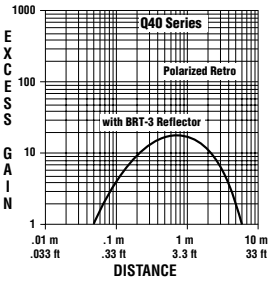
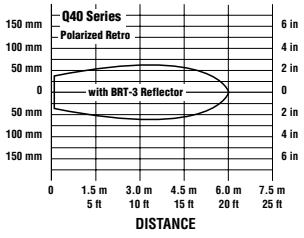


NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

P

Visible red, 680 nm

Q40 Polarized Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q40SN6LP **Q40SN6LPQ**	6 m (20')	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
Q40SP6LP **Q40SP6LPQ**		2 m (6.5') 4-Pin Euro QD		PNP		
Q40AW3LP **Q40AW3LPQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
Q40RW3LP **Q40RW3LPQ1**		2 m (6.5') 4-Pin Micro QD		DO		

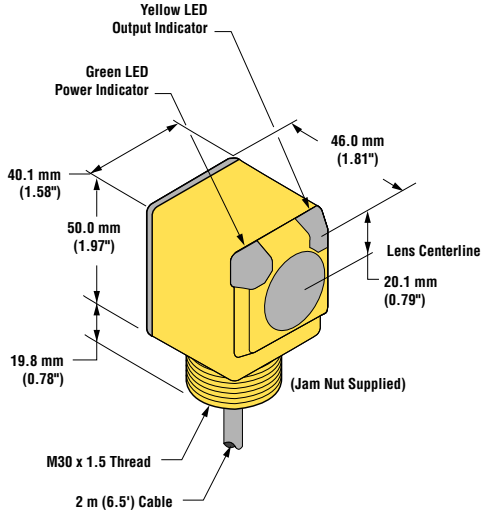
For EZ-BEAM Q40 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q40SN6LP W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.

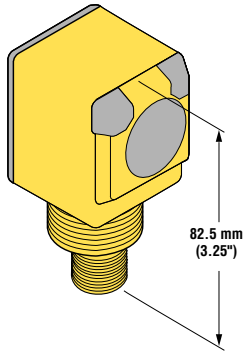
Q40 Dimensions

Q40 Sensor - All Cabled Models



Q40 Sensor - All Quick-Disconnect Models

DC Sensors with Euro-Style QD
AC Sensors with Micro-Style QD



NOTES:

T18 Series Sensors

T18 quick-disconnect ac model with right-angle cable (left) and cabled dc model (right) versions shown

- Patented† right-angle thermoplastic polyester housing with 18 mm threaded lens
- Advanced self-diagnostics with separate alarm output†; dual LED system indicates sensor performance
- Choice of integral cable or euro-style quick-disconnect connector
- 10 to 30V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA max. ea.)
- 20 to 250V ac (3-wire hookup); SPST solid-state switch output, maximum load 300 mA

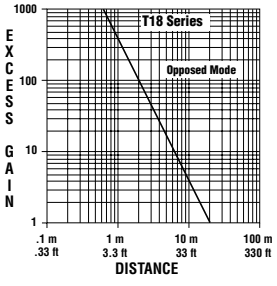
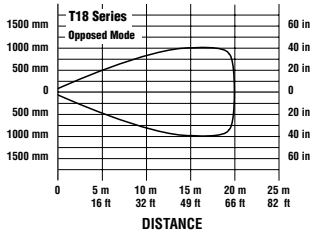
Note: Also see T18 Series sensors for device level bus networks, beginning on page 216.

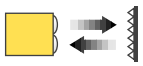
† U.S. design patent D361057

T18 Sensing Mode Options

Infrared, 950 nm

T18 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
T186E **T186EQ**	20 m (66')	2 m (6.5') 4-Pin Euro QD	10-30V dc	—		Effective Beam: 13 mm 
T18SN6R **T18SN6RQ**		2 m (6.5') 4-Pin Euro QD		NPN		
T18SP6R **T18SP6RQ**		2 m (6.5') 4-Pin Euro QD		PNP		
T183E **T183EQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	—		
T18AW3R **T18AW3RQ1**		2 m (6.5') 4-Pin Micro QD		LO		
T18RW3R **T18RW3RQ1**		2 m (6.5') 4-Pin Micro QD		DO		



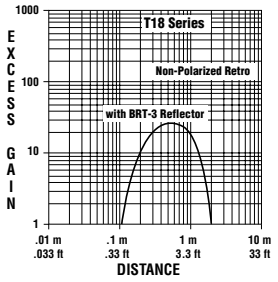
Non-Polarized

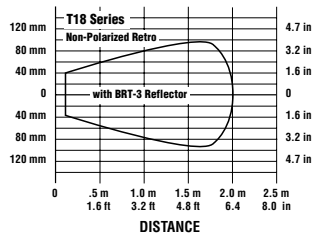
Polarized

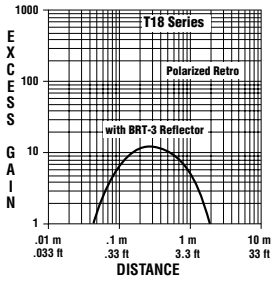
NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

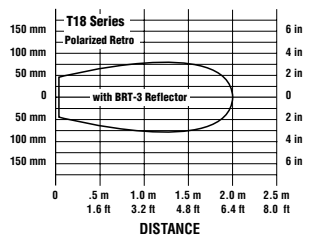
T18 Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized with Gain Control (Infrared, 950 nm)						
T18SN6L **T18SN6LQ**	2 m (79")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
T18SP6L **T18SP6LQ**		2 m (6.5') 4-Pin Euro QD		PNP		
T18AW3L **T18AW3LQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
T18RW3L **T18RW3LQ1**		2 m (6.5') 4-Pin Micro QD		DO		
Polarized (Visible red, 680 nm)*						
T18SN6LP **T18SN6LPQ**	2 m (79")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
T18SP6LP **T18SP6LPQ**		2 m (6.5') 4-Pin Euro QD		PNP		
T18AW3LP **T18AW3LPQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
T18RW3LP **T18RW3LPQ1**		2 m (6.5') 4-Pin Micro QD		DO		







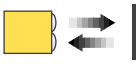


*Note: Use polarized models when shiny objects will be sensed.

For EZ-BEAM T18 Series Sensors:

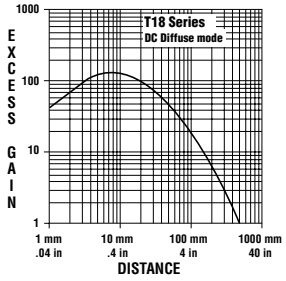
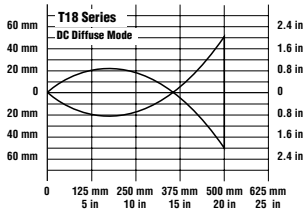
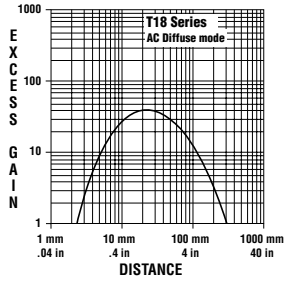
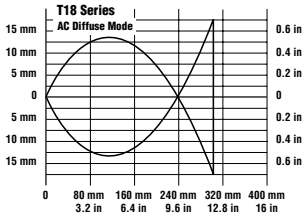
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **T18SN6LP W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.



Infrared, 880 nm

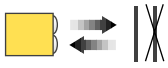
T18 Diffuse Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
With Gain Control (DC)						
T18SN6D **T18SN6DQ**	500 mm (20")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
T18SP6D **T18SP6DQ**		2 m (6.5') 4-Pin Euro QD		PNP		
With Gain Control (AC)						
T18AW3D **T18AW3DQ1**	300 mm (12")	2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
T18RW3D **T18RW3DQ1**		2 m (6.5') 4-Pin Micro QD		DO		

For EZ-BEAM T18 Series Sensors:

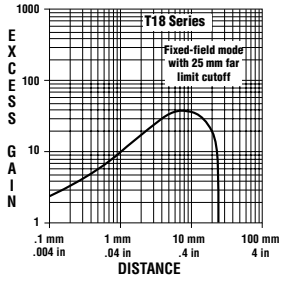
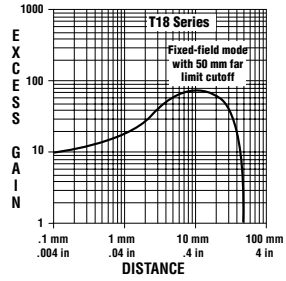
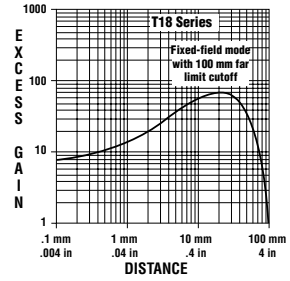
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **T18AW3D W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.



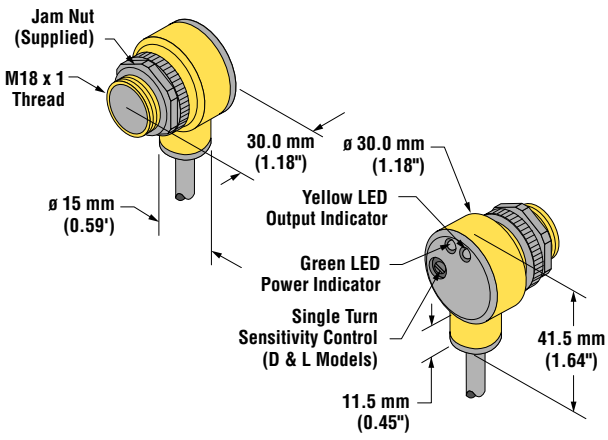
Infrared, 880 nm

T18 Fixed-Field Mode

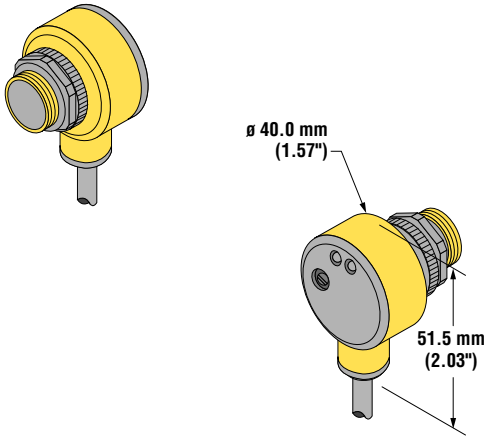
Models	Cutoff Point	Cable	Supply Voltage	Output Type	Excess Gain Performance based on 90% reflectance white test card
With 25 mm Far Limit Cutoff					
T18SN6FF25 **T18SN6FF25Q**	25 mm (1")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
T18SP6FF25 **T18SP6FF25Q**		2 m (6.5') 4-Pin Euro QD		PNP	
T18AW3FF25 **T18AW3FF25Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
T18RW3FF25 **T18RW3FF25Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 50 mm Far Limit Cutoff					
T18SN6FF50 **T18SN6FF50Q**	50 mm (2")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
T18SP6FF50 **T18SP6FF50Q**		2 m (6.5') 4-Pin Euro QD		PNP	
T18AW3FF50 **T18AW3FF50Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
T18RW3FF50 **T18RW3FF50Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 100 mm Far Limit Cutoff					
T18SN6FF100 **T18SN6FF100Q**	100 mm (4")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
T18SP6FF100 **T18SP6FF100Q**		2 m (6.5') 4-Pin Euro QD		PNP	
T18AW3FF100 **T18AW3FF100Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
T18RW3FF100 **T18RW3FF100Q1**		2 m (6.5') 4-Pin Micro QD		DO	

T18 Dimensions

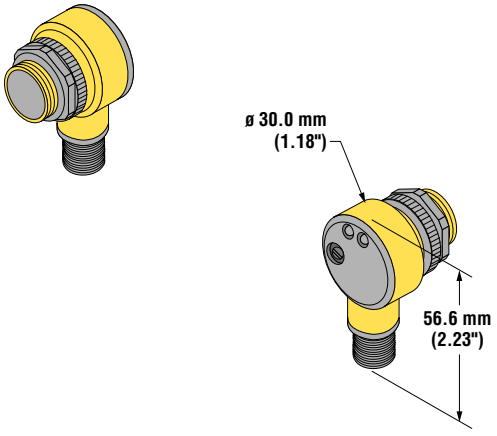
T18 DC Sensor



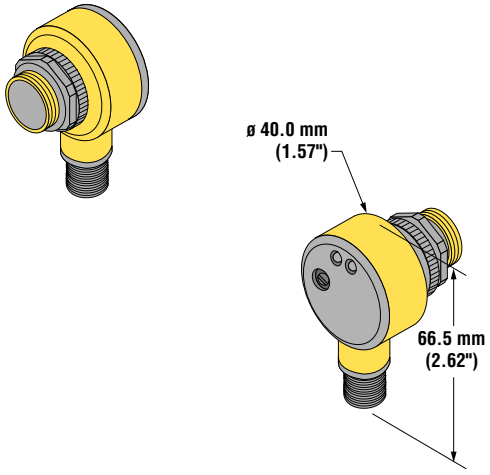
T18 AC Sensor



T18 DC Sensor with Euro-Style QD



T18 AC Sensor with Micro-Style QD



NOTES:

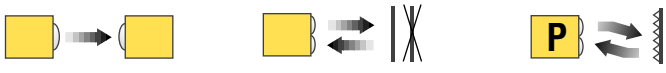
T30 Series Sensors

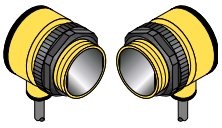
T30 quick-disconnect with right-angle cable (left) and cabled (right) versions shown

- Patented† right-angled thermoplastic polyester housing with 30 mm threaded lens
- Advanced self-diagnostics with separate alarm output†; dual LED system indicates sensor performance
- Choice of integral cable or euro-style quick-disconnect connector
- 10 to 30V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA max. ea.)
- 20 to 250V ac (3-wire hookup); SPST solid-state switch output, maximum load 300 mA

† U.S. design patent D361057

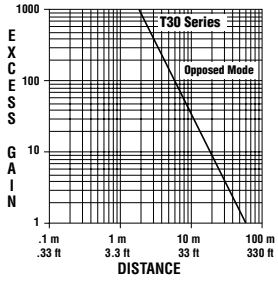
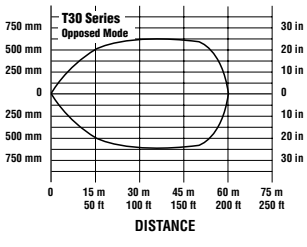
T30 Sensing Mode Options

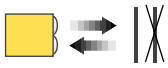




Infrared, 950 nm

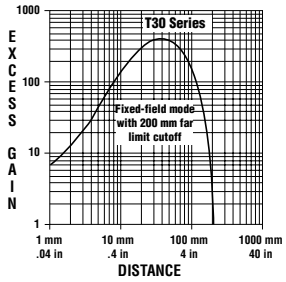
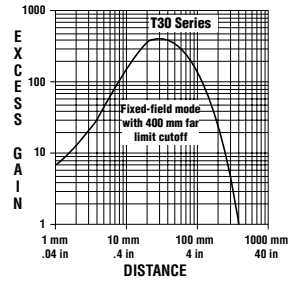
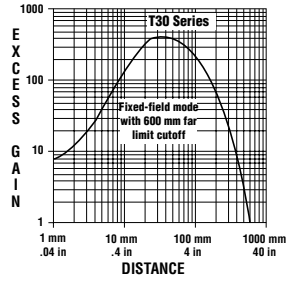
T30 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
T306E **T306EQ**	60 m (200')	2 m (6.5') 4-Pin Euro QD	10-30V dc	—		Effective Beam: 23 mm 
T30SN6R **T30SN6RQ**		2 m (6.5') 4-Pin Euro QD		NPN		
T30SP6R **T30SP6RQ**		2 m (6.5') 4-Pin Euro QD		PNP		
T303E **T303EQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	—		
T30AW3R **T30AW3RQ1**		2 m (6.5') 4-Pin Micro QD		LO		
T30RW3R **T30RW3RQ1**		2 m (6.5') 4-Pin Micro QD		DO		



Infrared, 950 nm

T30 Fixed-Field Mode

Models	Cutoff Point	Cable	Supply Voltage	Output Type	Excess Gain Performance based on 90% reflectance white test card
With 200 mm Far Limit Cutoff					
T30SN6FF200 **T30SN6FF200Q**	200 mm (8")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
T30SP6FF200 **T30SP6FF200Q**		2 m (6.5') 4-Pin Euro QD		PNP	
T30AW3FF200 **T30AW3FF200Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
T30RW3FF200 **T30RW3FF200Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 400 mm Far Limit Cutoff					
T30SN6FF400 **T30SN6FF400Q**	400 mm (16")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
T30SP6FF400 **T30SP6FF400Q**		2 m (6.5') 4-Pin Euro QD		PNP	
T30AW3FF400 **T30AW3FF400Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
T30RW3FF400 **T30RW3FF400Q1**		2 m (6.5') 4-Pin Micro QD		DO	
With 600 mm Far Limit Cutoff					
T30SN6FF600 **T30SN6FF600Q**	600 mm (24")	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN	
T30SP6FF600 **T30SP6FF600Q**		2 m (6.5') 4-Pin Euro QD		PNP	
T30AW3FF600 **T30AW3FF600Q1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO	
T30RW3FF600 **T30RW3FF600Q1**		2 m (6.5') 4-Pin Micro QD		DO	

For EZ-BEAM T30 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **T306E W/30**)

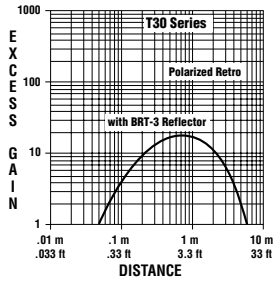
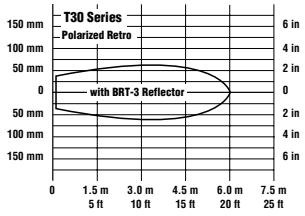
ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

P

Visible red, 680 nm

T30 Polarized Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
T30SN6LP **T30SN6LPQ**	6 m (20')	2 m (6.5') 4-Pin Euro QD	10-30V dc	NPN		
T30SP6LP **T30SP6LPQ**		2 m (6.5') 4-Pin Euro QD		PNP		
T30AW3LP **T30AW3LPQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	LO		
T30RW3LP **T30RW3LPQ1**		2 m (6.5') 4-Pin Micro QD		DO		

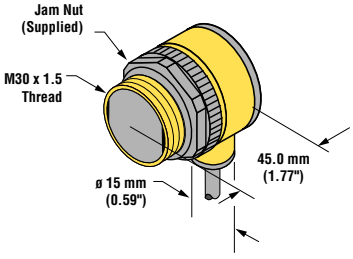
For EZ-BEAM T30 Series Sensors:

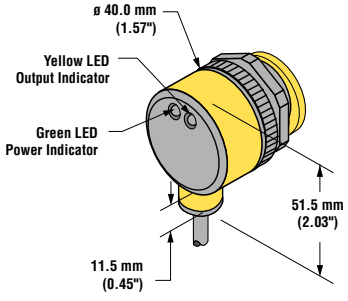
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **T30SN6LP W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.

T30 Dimensions

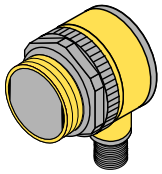
T30 Sensor - All Cabled Models

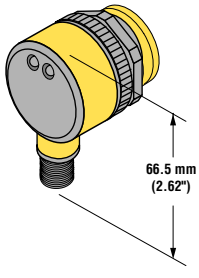




T30 Sensor - All Quick-Disconnect Models

DC Sensors with Euro-Style QD
AC Sensors with Micro-Style QD





NOTES:

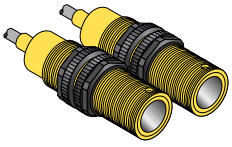
EZ-BEAM® SM30 Series Sensors

SM30 quick-disconnect (left) and cabled (right) versions shown

- 30 mm thermoplastic polyester threaded barrel with positive sealing at both ends
- Advanced self-diagnostics with separate alarm output†; dual LED system indicates sensor performance
- Choice of integral cable or euro-style quick-disconnect connector
- Exceeds NEMA 6P (IP67) leakproof rating; withstands equipment washdown environments
- 10 to 30V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA max. ea.)
- 20 to 250V ac (3-wire hookup); SPST solid-state switch output, maximum load 300 mA

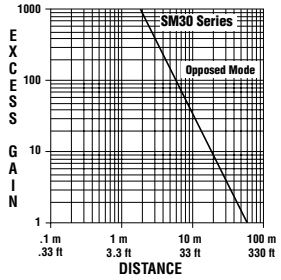
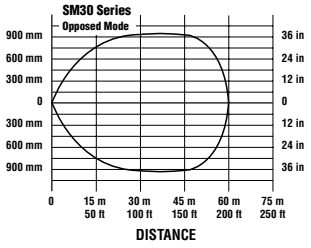
SM30 Sensing Mode Options

Opposed



Infrared, 880 nm

SM30 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SM306E **SM306EQ**	60 m (200')	2 m (6.5') 4-Pin Euro QD	10-30V dc	—		Effective Beam: 19 mm 
SM30SN6R **SM30SN6RQ**		2 m (6.5') 4-Pin Euro QD		NPN		
SM30SP6R **SM30SP6RQ**		2 m (6.5') 4-Pin Euro QD		PNP		
SM303E **SM303EQ1**		2 m (6.5') 4-Pin Micro QD	20-250V ac	—		
SM30AW3R **SM30AW3RQ1**		2 m (6.5') 4-Pin Micro QD		LO		
SM30RW3R **SM30RW3RQ1**		2 m (6.5') 4-Pin Micro QD		DO		

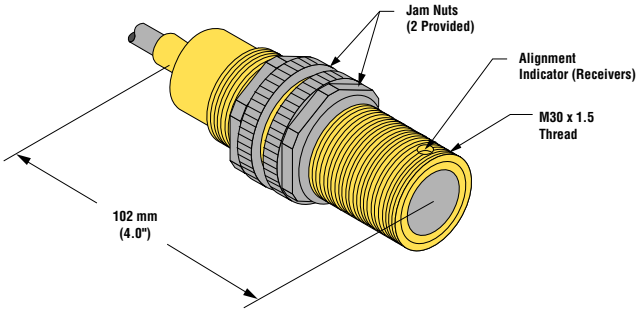
For EZ-BEAM SM30 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SM306E W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 232 and the Accessories section for more information.

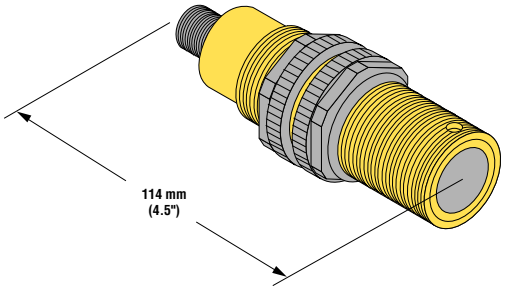
SM30 Dimensions

SM30 Sensor - All Cabled Models



SM30 Sensor - All Quick-Disconnect Models

DC Sensors with Euro-Style QD
AC Sensors with Micro-Style QD



EZ-BEAM DC Specifications*

Supply Voltage and Current Opposed Mode Emitters: Opposed Mode Receivers: Polarized Retro: Non-polarized Retro: Fixed-field: Diffuse:	10 to 30V dc (10% maximum ripple); Supply current (exclusive of load current): 25 mA 20 mA 30 mA 25 mA 35 mA 25 mA
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	SPDT (complementary) solid-state dc switch; Choose NPN (current sinking) or PNP (current sourcing) models. *Light operate:* N.O. output conducts when the sensor sees its own (or the emitter's) modulated light *Dark operate:* N.C. output conducts when the sensor sees dark; The N.C. (normally closed) output may be wired as a normally open marginal signal alarm output, depending upon hookup to the power supply (U.S. patent 5087838)
Output Rating	150 mA maximum (each) in standard hookup (100 mA max. for S12 receivers); When wired for alarm output, the total load may not exceed 150 mA (100 mA max. for S12 receivers); **Off-state leakage current** <1 microamp at 30V dc; **On-state saturation voltage** <1V at 10 mA dc; <1.5V at 150 mA dc
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs
Output Response Time	**Opposed:** 3 milliseconds "ON", 1.5 milliseconds "OFF"; **Polarized Retro, Non-Polarized Retro, Fixed-field and Diffuse:** 3 milliseconds "ON" and "OFF" NOTE: 100 millisecond delay on power-up; outputs are non-conducting during this time
Repeatability	**Opposed mode:** 375 microseconds; **Polarized Retro, Non-Polarized Retro, Fixed-field and Diffuse modes**: 750 microseconds; Repeatability and response are independent of signal strength
Adjustments	T18 Series infrared non-polarized retro and diffuse mode models (only) have a single-turn rear-panel SENSITIVITY control for adjustment of system gain (turn clockwise to increase)
Indicators	Two LEDs: Green and Yellow GREEN **glowing steadily** = power to sensor is "ON" GREEN **flashing** = output is overloaded (dc models only) YELLOW **glowing steadily** = normally open output is conducting YELLOW **flashing** = excess gain marginal (1-1.5x) in light condition
Construction	Housings are thermoplastic polyester (Except M18 which has stainless steel housing); Lenses are Lexan® (opposed models except SM30) or acrylic; S12, S18, M18, S30, and SM30 models come with two jam nuts; T18, T30, Q25, and Q40 models come with one jam nut; SM30 EZ-BEAMs have M30x1.5 threaded barrel housings with positive sealing at both ends to eliminate all leakage paths (including capillary leakage); Lenses are acrylic and quad-ring sealed
Environmental Rating	Leakproof design rated NEMA 6P (IEC IP67), except for SM30 EZ-BEAMs, which exceed NEMA 6P rating
Connections	2 m (6.5') or 9 m (30') attached cable, or 4-pin euro-style quick-disconnect fitting; S12 Series sensors use a pico-style QD
Operating Conditions	**Temperature:** -40° to +70°C (-40° to 158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration; frequency 10 to 60 Hz, max., double amplitude 0.06-inch acceleration 10G). Method 213B conditions H&I (Shock: 75G with unit operating; 100G for non-operation)
Certifications	CE [2] CSA® [1] UL LISTED [1]

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* Except S186ELD, T18U, S2 and T18X Series – see Specifications charts in those sections

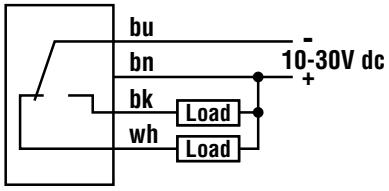
[1] S12, M18, and SM30 sensors do not have UL or CSA approval

[2] M18 sensor does not have CE approval

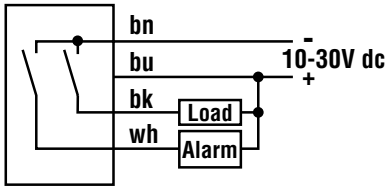
EZ-BEAM DC Hookup Diagrams

DC Sensors with NPN (Sinking) Outputs

Standard Hookup

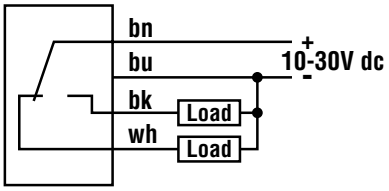


Alarm Hookup

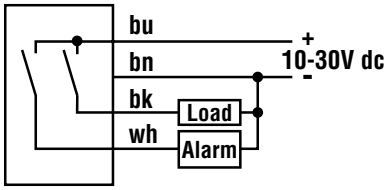


DC Sensors with PNP (Sourcing) Outputs

Standard Hookup

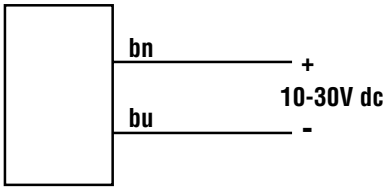


Alarm Hookup



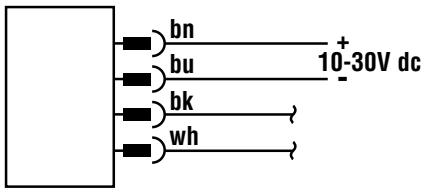
NOTE: DC hookups are the same for either an integral or QD cable.

DC Emitters with Attached Cable

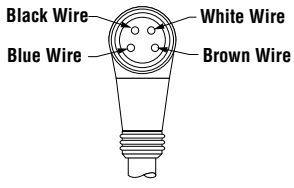


DC Emitters with Quick-Disconnect

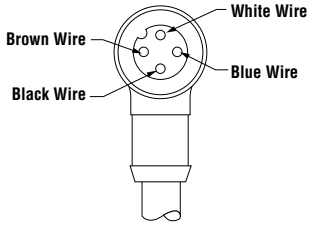
Note: No connection to bk and wh wires of QD cable.



4-Pin Pico-Style Pin-out - S12 Receivers (Cable Connector Shown)



Euro-Style Pin-out - All Other dc Models (Cable Connector Shown)



Quick-Disconnect (QD) Option

EZ-BEAM Sensors are sold either with a 2 m (6.5') or 9 m (30') attached PVC-covered cable or with a 4-pin QD cable fitting.

DC QD sensors are identified by the letter “Q” in their model number suffix. For more information on QD cable, see page 232 and the Accessories section.

EZ-BEAM AC Specifications

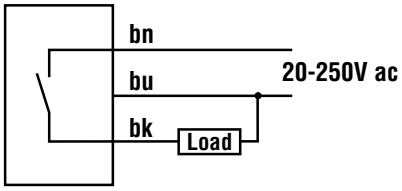
Supply Voltage and Current	20 to 250V ac (50/60 Hz). Average current 20 mA. Peak current: 200 mA at 20V ac, 500 mA at 120V ac, 750 mA at 250V ac
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	SPST solid-state AC switch; Three-wire hookup; Choose light operate or dark operate models; *Light operate models:* Output conducts when the sensor sees its own (or the emitter's) modulated light *Dark operate models:* Output conducts when sensor sees dark
Output Rating	300 mA maximum (continuous) Fixed-field models: derate 5 mA/°C above +50°C (122°F); **Inrush capability** 1 amp for 20 milliseconds, non-repetitive **Off-state leakage current** <100 microamps **On-state voltage drop** 3V at 300 mA ac; 2V at 15 mA ac
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	Opposed Mode: 16 milliseconds "ON", 8 milliseconds "OFF"; Polarized Retro, Non-polarized Retro, Fixed-field, and Diffuse: 16 milliseconds "ON" and "OFF" NOTE: 100 millisecond delay on power-up
Repeatability	**Opposed Mode:** 2 milliseconds; **Polarized Retro, Non-polarized Retro, Fixed-field, and Diffuse**: 4 milliseconds. Repeatability and response are independent of signal strength.
Adjustments	T18 Series infrared non-polarized retro and diffuse mode models (only) have a single-turn rear-panel SENSITIVITY control for adjustment of system gain (turn clockwise to increase)
Indicators	Two LEDs: Green and Yellow GREEN **glowing steadily** = power to sensor is "ON" YELLOW **glowing steadily** = sensor sees light YELLOW **flashing** = excess gain marginal (1-1.5x) in light condition
Construction	Housings are thermoplastic polyester ; Lenses are Lexan® (opposed models except SM30) or acrylic; S18, S30, and SM30 models come with two jam nuts; T18, T30, Q25, and Q40 models come with one jam nut; SM30 EZ-BEAMs have M30x1.5 threaded barrel housings with positive sealing at both ends to eliminate all leakage paths (including capillary leakage); Lenses are acrylic and quad-ring sealed
Environmental Rating	Leakproof design rated NEMA 6P (IEC IP67), except for SM30 EZ-BEAMs, which exceed NEMA 6P rating
Connections	2 m (6.5') or 9 m (30') attached cable, or 4 pin micro-style quick-disconnect fitting
Operating Conditions	**Temperature:** -40° to +70°C (-40° to 158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration; frequency 10 to 60 Hz, max, double amplitude 0.06-inch acceleration 10G). Method 213B conditions H&I (Shock: 75G with unit operating; 100G for non-operation)
Certifications	CE, CSA® [1], UL LISTED [1]

Lexan® is a registered trademark of General Electric Co.

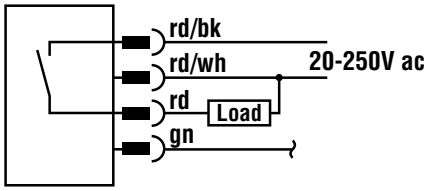
[1] SM30 sensors do not have UL or CSA approval

EZ-BEAM AC Hookup Diagrams

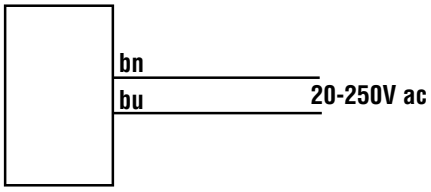
AC Sensors with Attached Cable



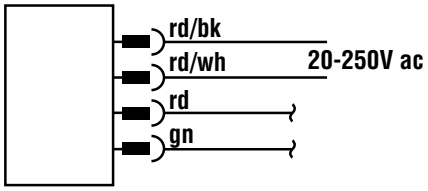
AC Sensors with QD Cable 4-Pin Micro-Style



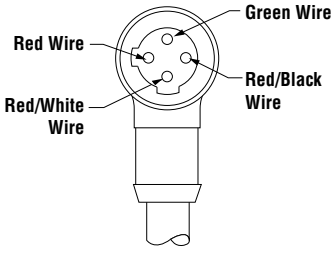
AC Emitter with Attached Cable



AC Emitter with QD Cable 4-Pin Micro-Style



Micro-Style Pin-Out (Cable Connector Shown)



Quick-Disconnect (QD) Option

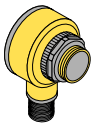
EZ-BEAM Sensors are sold either with a 2 m (6.5') or 9 m (30') attached PVC-covered cable or with a 4-pin QD cable fitting.

AC QD sensors are identified by the “Q1” in their model number suffix. Mating cables for EZ-BEAM QD sensors are model MQAC-415 (straight connector) or MQAC-415RA (right-angled connector). For more information on QD cable, see page 232 and the Accessories section.

T18X Sensors for Bus Networks

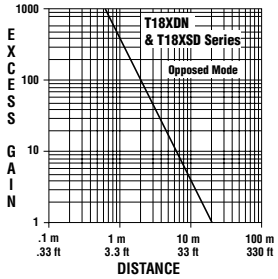
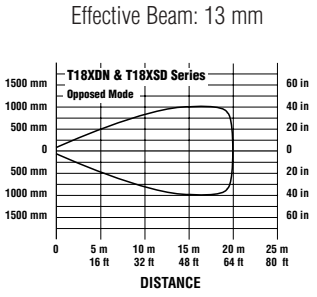
- Advanced self-diagnostics with separate alarm output; dual LED system indicates sensor performance
- T18XDN “smart” sensors can be wired to a DeviceNet bus network using simple “dumb drop” junction boxes or “T” connectors; T18XSD sensors wire directly to an SDS bus
- Quick-disconnect connector for standard euro-style DeviceNet or SDS compatible cables available from Interlink BT
- Epoxy-encapsulated circuitry; leakproof IP67 (NEMA 6P) rating for harsh sensing environments
- Brackets available for several mounting options

T18X Sensing Mode Options



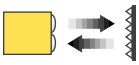
Infrared, 950 nm

T18X Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Excess Gain	Beam Pattern
T18XDN1EQ6	20 m (66')	DeviceNet compatible 5-pin Euro QD	11-25V dc		
T18XSD1EQ		SDS compatible 4-pin Euro QD			
T18XDN1RQ6		DeviceNet compatible 5-pin Euro QD			
T18XSD1RQ		SDS compatible 4-pin Euro QD			

For T18Xs:

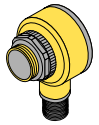
i) Sensors require a Euro-style quick-disconnect cable. Contact your Banner sales engineer for help with cable selection.



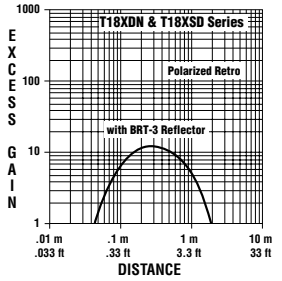
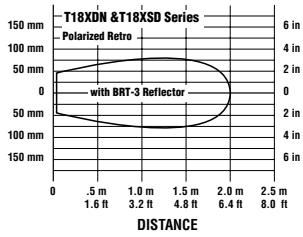
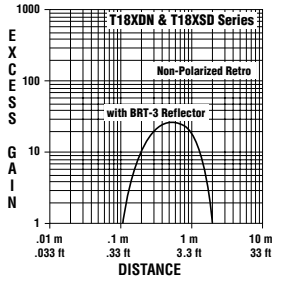
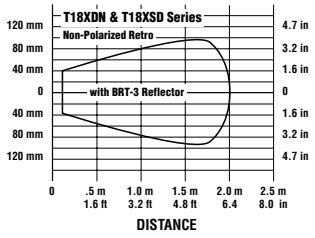
Infrared, 950 nm
Non-Polarized

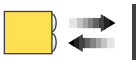
Visible red, 680 nm
Polarized

NOTE: Use polarized models when shiny objects will be sensed. Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



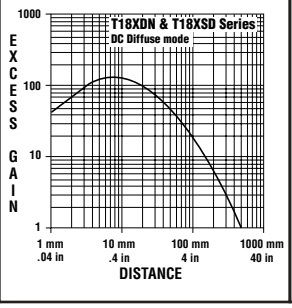
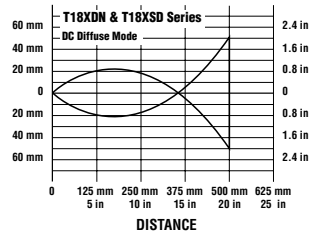
T18X Retroreflective Mode

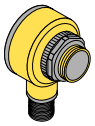
Models	Range	Cable	Supply Voltage	Excess Gain	Beam Pattern
Polarized					
T18XDN1LPQ6	2 m (79")	DeviceNet compatible 5-pin Euro QD	11-25V dc		
T18XSD1LPQ		SDS compatible 4-pin Euro QD			
Non-Polarized					
T18XDN1LQ6	2 m (79")	DeviceNet compatible 5-pin Euro QD	11-25V dc		
T18XSD1LQ		SDS compatible 4-pin Euro QD			

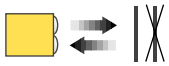


Infrared, 880 nm

T18X Diffuse Mode

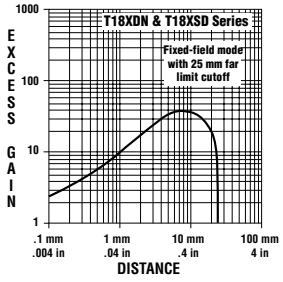
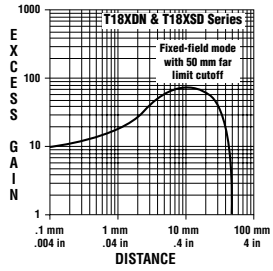
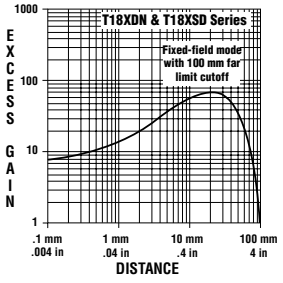
Models	Range	Cable	Supply Voltage	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
T18XDN1DQ6	500 mm (20")	DeviceNet compatible 5-pin Euro QD	11-25V dc		
T18XSD1DQ		SDS compatible 4-pin Euro QD			





Infrared, 880 nm

T18X Fixed-Field Mode

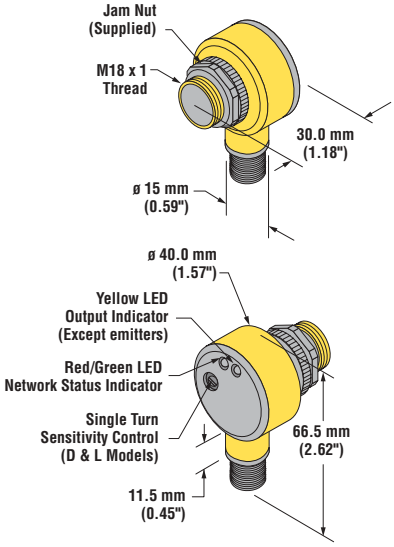
Models	Range	Cable	Supply Voltage	Excess Gain Performance based on 90% reflectance white test card
25 mm far limit cutoff				
T18XDN1FF25Q6	25 mm (1")	DeviceNet compatible 5-pin Euro QD	11-25V dc	
T18XSD1FF25Q		SDS compatible 4-pin Euro QD		
50 mm far limit cutoff				
T18XDN1FF50Q6	50 mm (2")	DeviceNet compatible 5-pin Euro QD	11-25V dc	
T18XSD1FF50Q		SDS compatible 4-pin Euro QD		
100 mm far limit cutoff				
T18XDN1FF100Q6	100 mm (4")	DeviceNet compatible 5-pin Euro QD	11-25V dc	
T18XSD1FF100Q		SDS compatible 4-pin Euro QD		

For T18Xs:

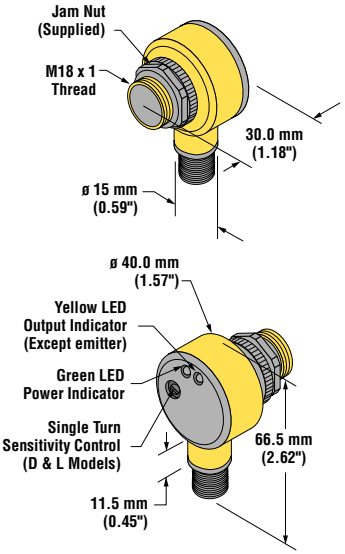
i) Sensors require a Euro-style quick-disconnect cable. Contact your Banner sales engineer for help with cable selection.

T18X Dimensions

T18XDN



T18XSD

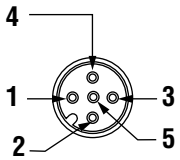


T18X Specifications

Supply Voltage and Current Opposed Mode Emitter Opposed Mode Receiver Polarized & Non Polarized Retro Diffuse Fixed-field	11 to 25V dc (10% maximum ripple); Supply current (exclusive of load current): 25 mA 45 mA 55 mA 55 mA 60 mA
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Output Response Time	**Opposed:** 3.5 milliseconds "ON" and 2.0 milliseconds "OFF" **Polarized Retro and Fixed-field:** 3.5 milliseconds "ON" and "OFF" *NOTE: 100 millisecond delay on power-up; outputs are non-conducting during this time*
Repeatability	**Opposed:** 575 microseconds **Polarized Retro and Fixed-field:** 950 microseconds Repeatability and response are independent of signal strength
Indicators	**T18XDN models:** Two LEDs: a bi-colored (red/green) LED and a Yellow LED The bi-color LED indicates the status of the network GREEN **Glowing Steadily** = Sensor on line, connected to master GREEN **Flashing** = Sensor on line - address + baud rate are ok RED **Glowing Steadily** = Critical network fault or duplicate node address detected; wrong baud rate RED **Flashing** = Minor or connection time out fault YELLOW **Glowing Steadily** = Normally open output is conducting YELLOW **Flashing** = Excess gain marginal (1-1.5x) in light condition **T18XSD models:** Two LEDs: One Green LED and one Yellow LED GREEN **Glowing Steadily** = Power to the sensor YELLOW **LED** = Sensor signal YELLOW **Glowing Steadily** = Normally open output is conducting YELLOW **Flashing** = Excess gain marginal (1-1.5x) in light condition
Sensor Configuration for T18XDN models only	Change of State Connection: which responds to a slave's change of state. I/O Response is with the following 8-bit word data: Bit 0: 0 Output is "OFF" 1 Output is "ON" Bit 1: 0 Alarm output is "OFF" 1 Alarm output is "ON" Bit 2-7: Not Used: Always 0 Notes: Configuration may be simplified through use of an Electronic Data Sheet (Banner model EDS 40223)
Construction	Housings are thermoplastic polyester; lenses are Lexan® (opposed models) or acrylic (retro and fixed-field models) T18X models come with one jam nut
Environmental Rating	Leakproof design rated NEMA 6P; IEC IP67
Connections	**T18XDN models:** 5-pin euro-style DeviceNet™ compatible quick-disconnect fitting; cables are ordered separately. **T18XSD models:** 4-pin euro-style SDS™ compatible quick-disconnect fitting; cables ordered separately. Contact your Banner sales engineer or Interlink BT for cable information.
Operating Conditions	**Temperature:** -25° to +70°C (-13° to 158°F) **Relative Humidity:** 90% at 50°C (non-condensing)
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration; frequency 10 to 60 Hz, max., double amplitude 0.06" acceleration 10G). Method 213B conditions H&I (Shock: 75G with unit operating; 100G for non-operation)
Certifications	CE

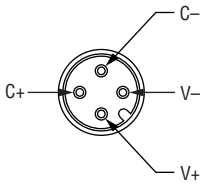
Lexan® is a registered trademarks of General Electric Co.

T18XDN Hookup Information

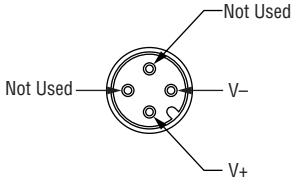
T18XDN DeviceNet™ Hookup			
T18X Male Connector	**Pin**	**Wire Color**	**Function**
Male Pinout 	1		Shield
	2	Red	BUS power (+V)
	3	Black	BUS power (-V)
	4	White	Communications +
	5	Blue	Communications -

T18XSD Hookup Information

Quick Disconnect Pin Detail (Except Emitter)
connector on sensor shown (male pins)

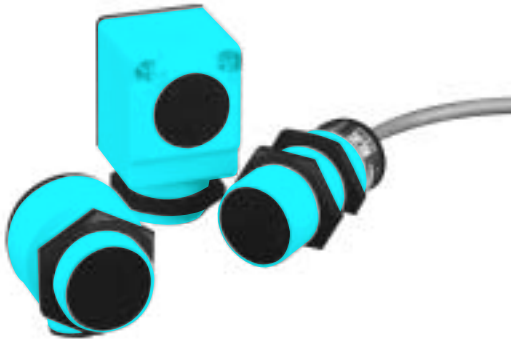


Emitter Quick Disconnect Pin Detail
connector on sensor shown (male pins)



Contact factory or Interlink BT for mating cable information

S2 Series Sensors for Bus Networks

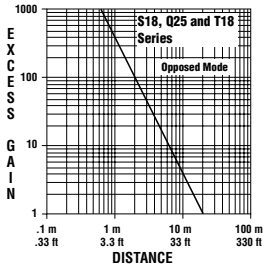
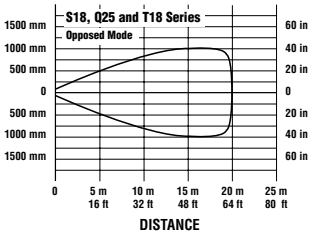
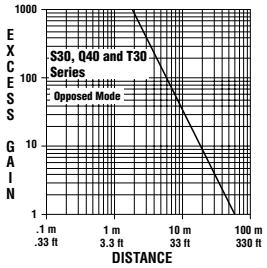
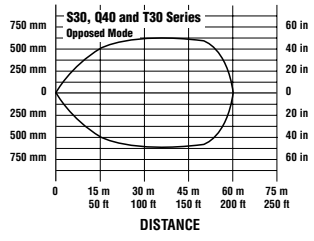


- Standard photoelectric sensors with bus network-compatible connection
- Solid-state outputs for direct connection to a “smart” BUS system network junction
- 4-pin quick-disconnect connector for standard euro-style extension cables
- Advanced self-diagnostics with separate alarm output; dual LED system indicates sensor performance
- Epoxy-encapsulated circuitry; leakproof IP67 (NEMA 6P) rating for harsh sensing environments
- Brackets available for several mounting options

EZ-BEAM S2 Sensing Mode Options

Infrared, 950 nm

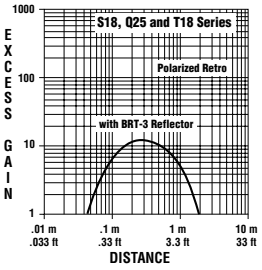
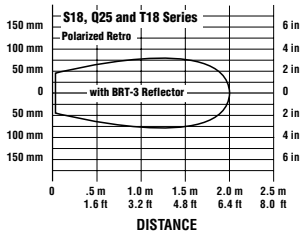
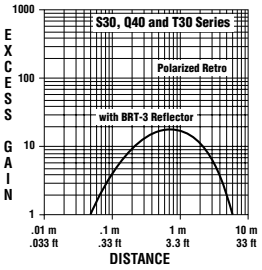
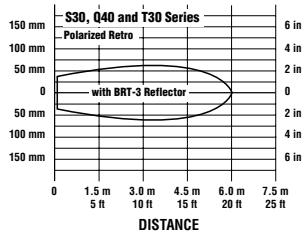
EZ-BEAM S2 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
S186EQ **S18S2P6RQ**	20 m (66')	4-pin Euro QD	10-30V dc	PNP		Effective Beam: 13 mm 
Q256EQ **Q25S2P6RQ**						
T186EQ **T18S2P6RQ**						
S306EQ **S30S2P6RQ**	60 m (200')	4-pin Euro QD	10-30V dc	PNP		Effective Beam: 23 mm 
Q406EQ **Q40S2P6RQ**						
T306EQ **T30S2P6RQ**						

Visible red, 680 nm

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

EZ-BEAM S2 Polarized Retroreflective Mode

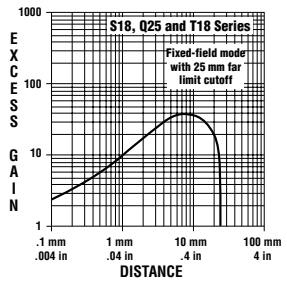
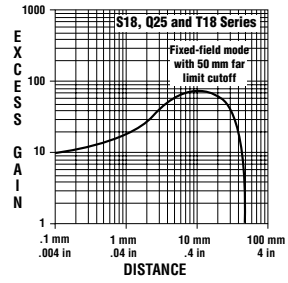
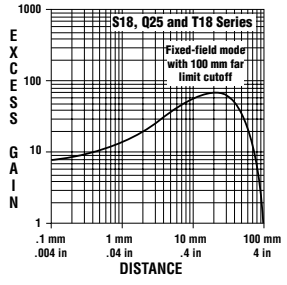
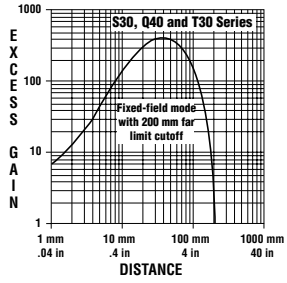
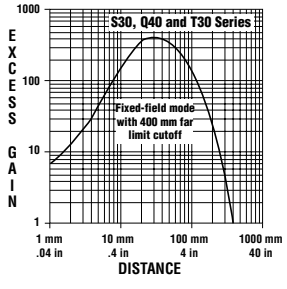
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
S18S2P6LPQ	2 m (79")	4-pin Euro QD	10-30V dc	PNP		
Q25S2P6LPQ						
T18S2P6LPQ						
S30S2P6LPQ	6 m (20')	4-pin Euro QD	10-30V dc	PNP		
Q40S2P6LPQ						
T30S2P6LPQ						

For EZ-BEAM S2 Sensors:

i) Sensors require a Euro-style quick-disconnect cable. Contact your Banner sales engineer for help with cable selection.

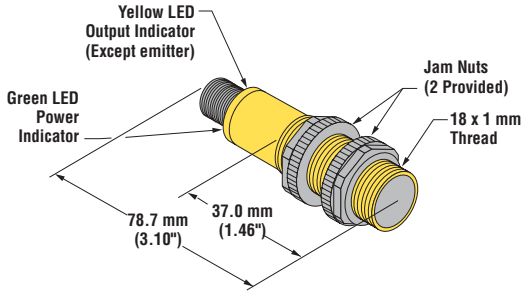
Infrared, 950 nm

EZ-BEAM S2 Fixed-Field Mode

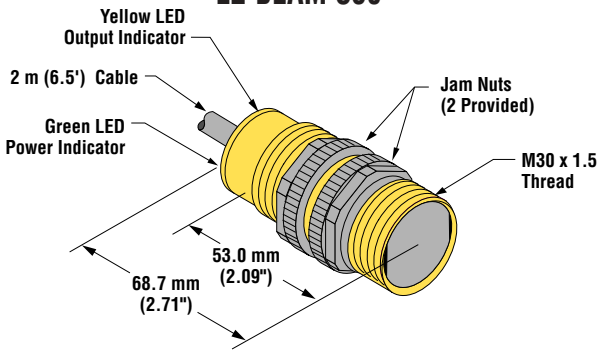
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain Performance based on 90% reflectance white test card
25 mm Far Limit Cutoff					
S18S2P6FF25Q	25 mm (1")	4-Pin Euro QD	10-30V dc	PNP	
Q25S2P6FF25Q					
T18S2P6FF25Q					
50 mm Far Limit Cutoff					
S18S2P6FF50Q	50 mm (2")	4-Pin Euro QD	10-30V dc	PNP	
Q25S2P6FF50Q					
T18S2P6FF50Q					
100 mm Far Limit Cutoff					
S18S2P6FF100Q	100 mm (4")	4-Pin Euro QD	10-30V dc	PNP	
Q25S2P6FF100Q					
T18S2P6FF100Q					
200 mm Far Limit Cutoff					
S30S2P6FF200Q	200 mm (8")	4-Pin Euro QD	10-30V dc	PNP	
Q40S2P6FF200Q					
T30S2P6FF200Q					
400 mm Far Limit Cutoff					
S30S2P6FF400Q	400 mm (16")	4-Pin Euro QD	10-30V dc	PNP	
Q40S2P6FF400Q					
T30S2P6FF400Q					

EZ-BEAM S2 Dimensions

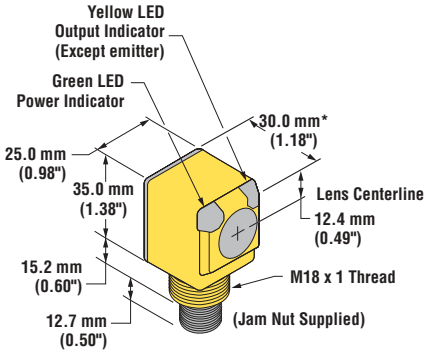
EZ-BEAM S18



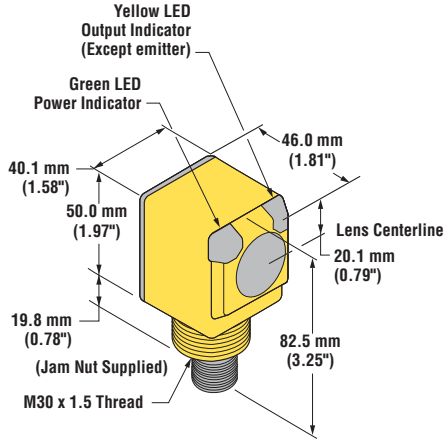
EZ-BEAM S30



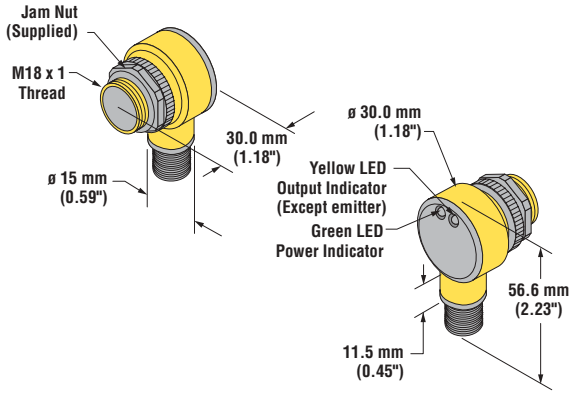
EZ-BEAM Q25



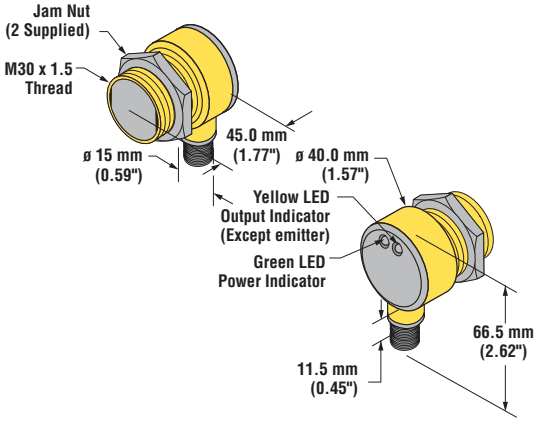
EZ-BEAM Q40



EZ-BEAM T18



EZ-BEAM T30



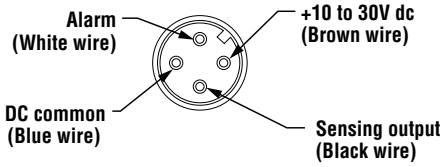
EZ-BEAM S2 Specifications

Supply Voltage and Current Opposed Mode Emitter Opposed Mode Receiver Polarized Retro Fixed-field	10 to 30V dc (10% maximum ripple); Supply current (exclusive of load current): 25 mA 20 mA 30 mA 35 mA	
Supply Protection Circuitry	Protected against reverse polarity and transient voltages	
Output Configuration	Sensing Output: PNP (current sourcing), light operated	Alarm Output: PNP (current sourcing), normally open and conducts whenever the sensor's excess gain drops to between 1X and 1.5X in the light condition
Output Rating	150 mA maximum (each); the total load may not exceed 150 mA; **Off-state leakage current** <1 microamp at 30V dc; **On-state saturation voltage** <1V at 10 mA dc; <1.5V at 150 mA dc	
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs	
Output Response Time	**Opposed:** 3 milliseconds "ON" and 1.5 milliseconds "OFF" **Polarized Retro and Fixed-field:** 3 milliseconds "ON" and "OFF" *NOTE: 100 millisecond delay on power-up; outputs are non-conducting during this time*	
Repeatability	**Opposed:** 375 microseconds **Polarized Retro and Fixed-field:** 750 microseconds Repeatability and response are independent of signal strength	
Indicators	Two LEDs: Green and Yellow GREEN **glowing steadily** = power to sensor is "ON" GREEN **flashing** = output is overloaded YELLOW **glowing steadily** = normally open output is conducting YELLOW **flashing** = excess gain marginal (1-1.5x) in light condition	
Construction	Housings are thermoplastic polyester; Lenses are Lexan® (opposed models) or acrylic (retro and fixed-field models) S18 and S30 come with two jam nuts; T18, T30, Q25 and Q40 come with one jam nut	
Environmental Rating	Leakproof design rated NEMA 6P; IEC IP67	
Connections	4-pin euro-style quick-disconnect fitting; cables are ordered separately; contact your Banner sales engineer for help with cable selection.	
Operating Conditions	**Temperature:** -40° to +70°C (-40° to 158°F) **Relative Humidity:** 90% at 50°C (non-condensing)	
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration; frequency 10 to 60 Hz, max., double amplitude 0.06" acceleration 10G). Method 213B conditions H&I (Shock: 75G with unit operating; 100G for non-operation)	

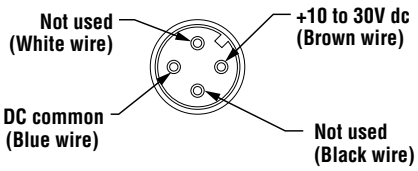
Lexan® is a registered trademark of General Electric Co.

EZ-BEAM S2 Hookup Information

Quick-Disconnect Pin Detail
Connector on Sensor Shown (male pins)



Emitter Quick-Disconnect Pin Detail
Connector on Sensor Shown (male pins)



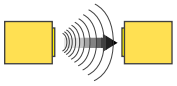
Note: Wire colors are for Banner MQDC-4 Series quick-disconnect cables

T18U Series Ultrasonic Sensors

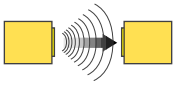
*U.S. Design Patent #D361057

- Opposed mode ultrasonic sensors for reliable detection of clear objects and materials
- Selectable resolution: NORMAL resolution with opposed range up to 600 mm (24"), HIGH resolution with range to 300 mm (12")
- Highly immune to ambient sonic and electrical noise
- Popular, patented* T-style right-angle sensor package with 18 mm threaded hub; cabled or quick disconnect models are available
- 12 to 30V dc operation; choose receivers with either NPN (sinking) or PNP (sourcing) output
- Alignment indicator flashes at a rate proportional to the received signal strength
- Rugged design for use in demanding environments: rated IEC IP67, NEMA 6P; wide operating temperature range of -40°C to +70°C

T18U Series Sensing Mode Options



Ultrasonic Opposed



Ultrasonic, 230 KHz

T18U Series Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Response Time
T186UE **T186UEQ**	Normal resolution: 600 mm (24") High resolution: 300 mm (12")	2 m (6.5') 4-Pin Euro QD	12-30V dc	—	Normal resolution: 2 milliseconds High resolution: 1 millisecond
T18VN6UR **T18VN6URQ**		2 m (6.5') 4-Pin Euro QD		Complementary NPN	
T18VP6UR **T18VP6URQ**		2 m (6.5') 4-Pin Euro QD		Complementary PNP	

For T18U Ultrasonic Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **T18VN6UR W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 232 and the Accessories section for more information.

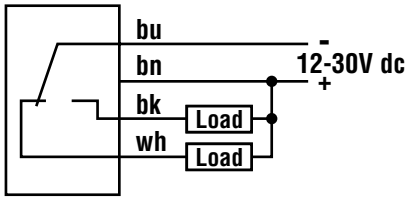
T18U Series Product Specifications

Emitter-Receiver Opposed Range	Normal resolution: 600 mm (24") max High resolution: 300 mm (12") max
Supply Voltage and Current	12 to 30V dc (10% maximum ripple) at 50 mA (emitters) or 35 mA (receivers), exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	SPDT (complementary) solid-state dc switch: Choose NPN (current sinking) or PNP (current sourcing) models
Output Rating	150 mA (each) at 25°C, derated to 100 mA at 70°C (derate 1 mA per °C) **Off-state leakage current** <1 microamp at 30V dc **On-state saturation voltage** <1.5V at 10m A; <2.0V at 150 mA
Output Supply Circuitry	Protected against false pulse on receiver power-up and continuous overload or short circuit of outputs
Output Response Time	NORMAL resolution mode: 2 milliseconds “on” and “off”; 125 Hz max. rep rate HIGH resolution mode: 1 millisecond “on” and “off”; 200 Hz max. rep rate
Indicators	Emitters have a green LED for dc power “on” Receivers have two LEDs, one yellow and one green: GREEN **glowing steadily** = power to receiver is “on” GREEN **flashing** = output is overloaded YELLOW **flashing** = sonic signal received (flash rate is proportional to received signal strength; flash is from half to full intensity)
Construction	Patented* T-style PBT housing. M18 x 1 transducer housing; mating jam nut is supplied for mounting; acoustic face is epoxy-reinforced; circuitry is epoxy-encapsulated
Environmental Rating	Leakproof design is rated IEC IP67; NEMA 6P
Connections	2 m (6.5') or 9 m (30') attached cable, or 4-pin euro-style quick-disconnect fitting
Operating Temperature	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 100%
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration: 10 to 60 Hz max., double amplitude 0.06" acceleration 10G). Method 213C conditions H & I (Shock: 75G with unit operation; 100F to non-operation) Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave
Application Notes	**Minimum spacing (adjacent sensor pairs):** 50 mm for emitter-to-receiver separations of up to 150 mm. Add 10 mm of adjacent-pair spacing for every 100 mm of emitter-to-receiver separation beyond 150 mm.
Certifications	CE

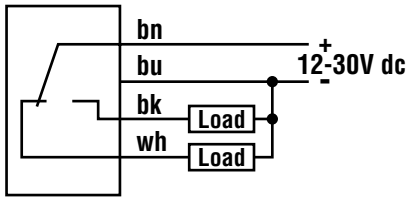
*U.S. Design Patent No. D361057

T18U Series Hookup Diagrams

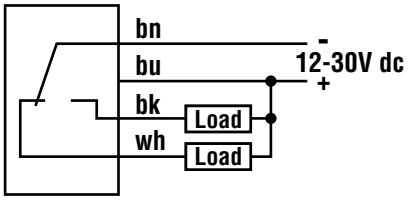
NPN (sinking) Receivers
T18VN6 Models
Hookup for Normal Resolution



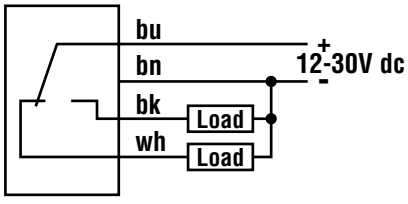
PNP (sourcing) Receivers
T18VP6 Models
Hookup for Normal Resolution



Hookup for High Resolution

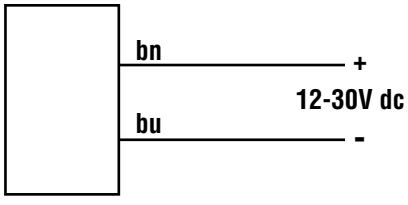


Hookup for High Resolution

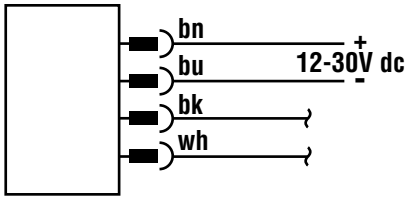


NOTE: The receiver hookups are the same for either an integral or QD cable. QD cables are 4-pin euro-style (see pin-out drawings on next page).

Cabled Emitters - T186UE



Quick Disconnect Emitters - T186UEQ



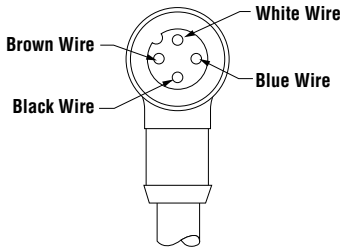
Quick-Disconnect (QD) Option

T18U Ultrasonic sensors are sold with either a 2 m (6.5') or a 9 m (30') attached cable, or with a 4-pin euro-style QD cable fitting.

QD sensors are identified by the letters “Q” in their model number suffix. Mating cables for QD T18U Ultrasonic sensors are model MQDC-415 or MQDC-430 (straight connectors) or MQDC-415RA or MQDC-430RA (right-angled connectors). For more information on QD cables, see page 232 and the Accessories section.

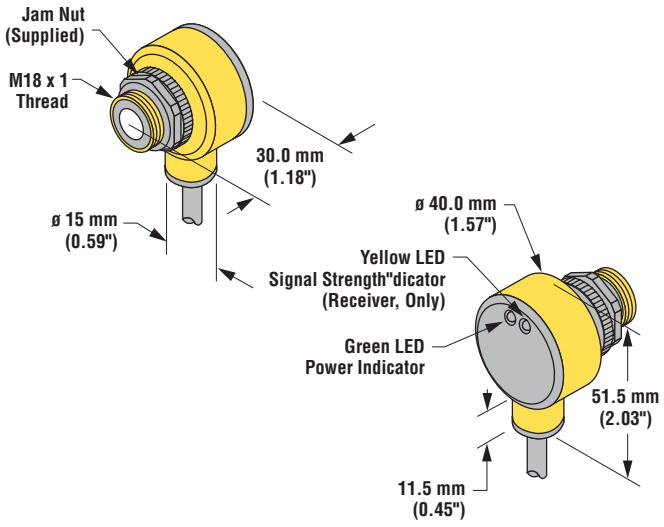
T18U Series Hookup Diagrams

4-Pin Euro-Style Pin-out
(Cable Connector Shown)

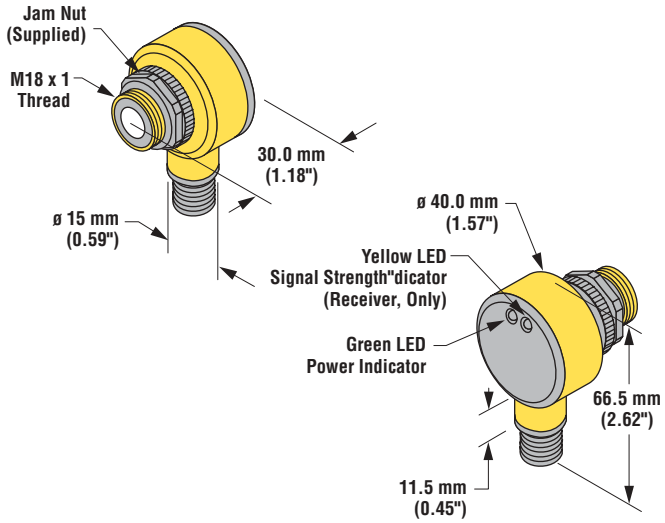


T18U Series Dimensions

T18U Sensor with Cable Attached



T18U Sensor with Euro-Style QD

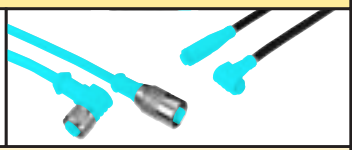


Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All EZ-BEAM sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	S18SN6D W/30

Quick-Disconnect (QD) Cables

The following is a selection of cables available for the EZ-BEAM QD models



Style	Model	Length	Connector	For use with
4-Pin Pico	**PKG4-2** **PKW4-2**	2 m (6.5')	Straight Right-Angle	S12 Series EZ-BEAM sensors with model suffix "QP"
4-Pin Euro	**MQDC-406** **MQDC-415** **MQDC-430** **MQDC-406RA** **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30') 2 m (6.5') 5 m (15') 9 m (30')	Straight Straight Straight Right-Angle Right-Angle Right-Angle	S18, S186ELD, S30, Q25, Q40, M18, T18, T30 and SM30 dc series EZ-BEAM sensors with model suffix "Q"
4-Pin Micro	**MQAC-406** **MQAC-415** **MQAC-430** **MQAC-406RA** **MQAC-415RA** **MQAC-430RA**	2 m (6.5') 5 m (15') 9 m (30') 2 m (6.5') 5 m (15') 9 m (30')	Straight Straight Straight Right-Angle Right-Angle Right-Angle	S18, S30, Q25, Q40, T18, T30 and SM30 ac series EZ-BEAM sensors with model suffix "Q1"

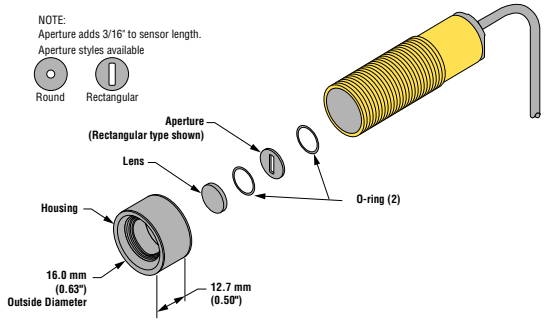
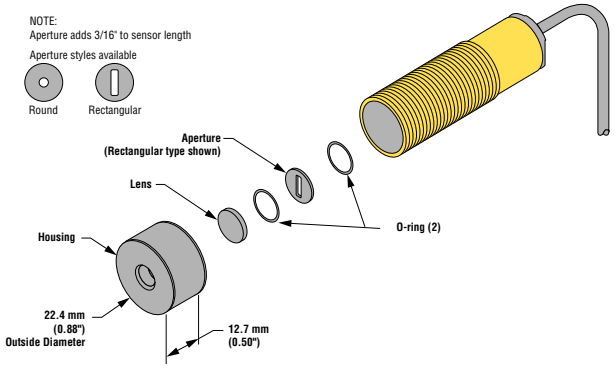
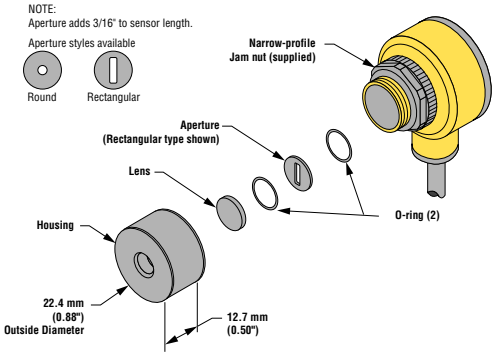
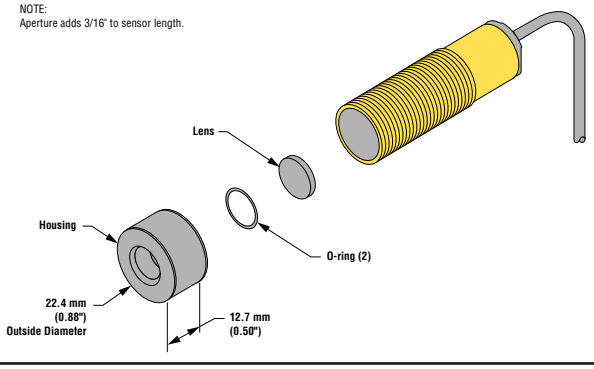
Extension Cables (without connectors)

The following cables are available for extending the length of existing sensor cable. These are 30 m (100') lengths of EZ-BEAM cable. This cable may be spliced to existing cable. Connectors, if used, must be customer-supplied.

Model	Type	Used with:
EC19E-100	2-conductor	S126E emitter
EC19R-100	4-conductor	S12 Series receivers
EC312A-100	2-conductor	M18, S18, S30, Q25, Q40, T18 & T30 Series emitters
EC312-100	4-conductor	M18, S18, S30, Q25, Q40, T18 & T30 Series dc sensors (except emitters)
EC900A-100	3-conductor	S18, S186ELD, S30, Q25, Q40, T18 & T30 Series ac sensors (except emitters)

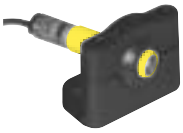
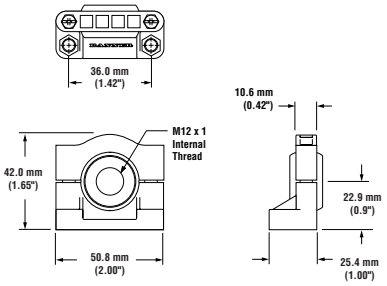
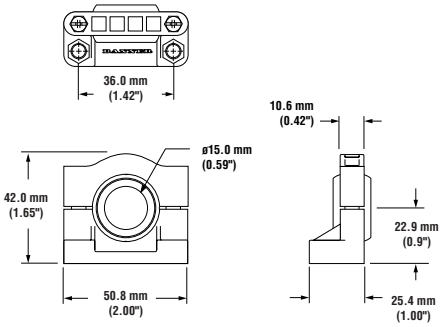
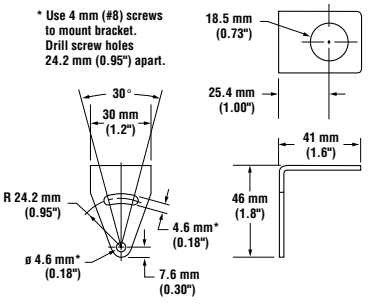
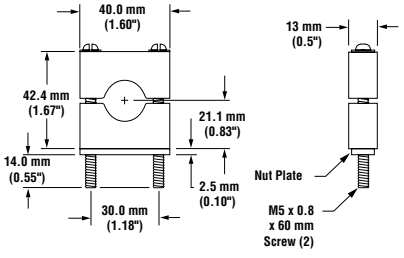
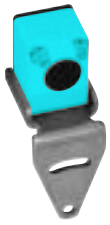
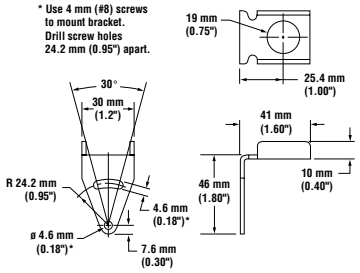
Aperture Kits

Selected EZ-BEAM sensors may be fitted with apertures which narrow or shape the effective beam of the sensor and protect the sensor's lens. These apertures are rectangular or circular thread-on water-tight parts. Use of apertures makes it possible to create very narrow, concentrated sensing beams for precision sensing applications. Kits include Teflon FEP® lens, o-rings and thread-on housing.

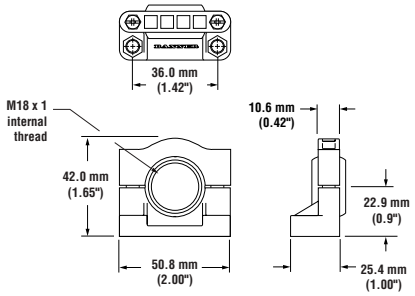
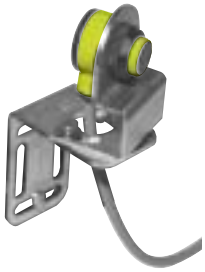
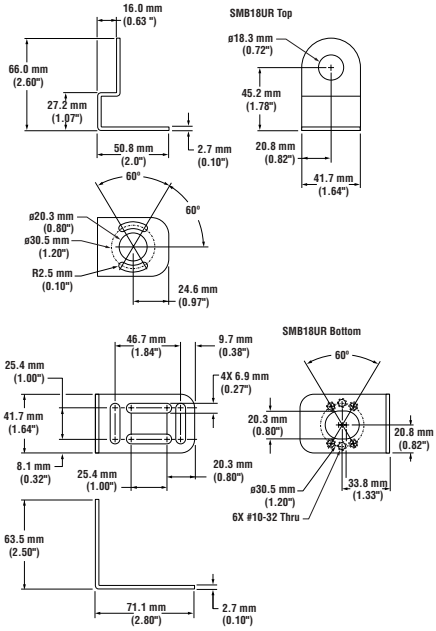
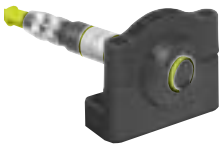
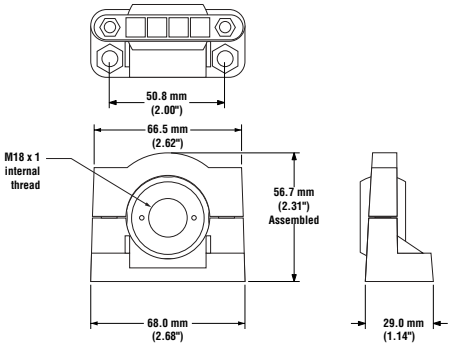
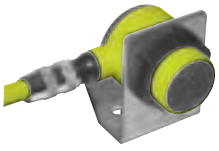
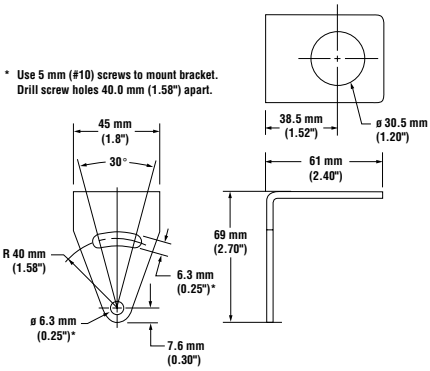
Model	Description	Used With	Dimensions
AP12SC	Kit includes round apertures of: 0.5 mm (0.02"), 1.0 mm (0.04") & 2.5 mm (0.10") in diameter	S12 Series	
AP12SR	Kit includes rectangular apertures of: 0.5 mm (0.02"), 1.0 mm (0.04") & 2.5 mm (0.10") wide		
AP18SC	Kit includes round apertures of: 0.5 mm (0.02"), 1.0 mm (0.04") & 2.5 mm (0.10") in diameter	S18 & M18 Series	
AP18SR	Kit includes rectangular apertures of: 0.5 mm (0.02"), 1.0 mm (0.04") & 2.5 mm (0.10") wide		
AP18SCN	Kit includes round apertures of: 0.5 mm (0.02"), 1.0 mm (0.04") & 2.5 mm (0.10") in diameter	T18 Series	
AP18SRN	Kit includes rectangular apertures of: 0.5 mm (0.02"), 1.0 mm (0.04") & 2.5 mm (0.10") wide		
APG18S	Kit includes glass lens (window) to protect plastic sensor lens from chemical environments	S18, M18 & T18 Series	

Note: For 30 mm aperture kit, see SM30 Accessories, page 295.

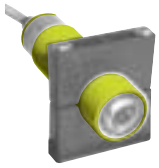
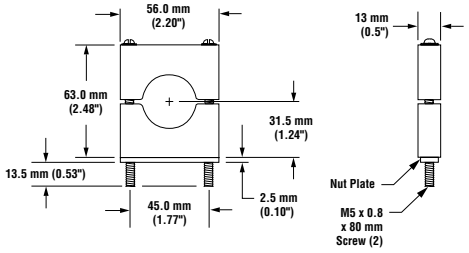
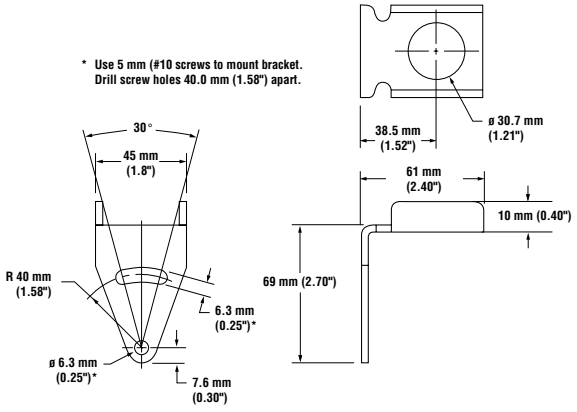
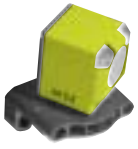
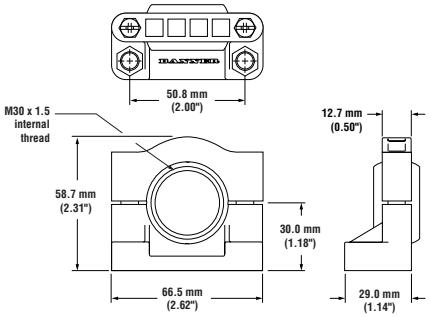
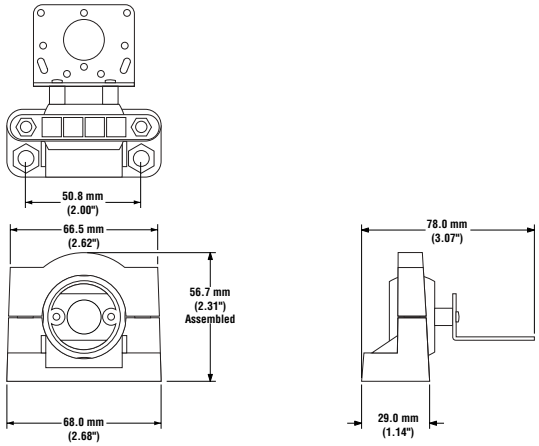
Mounting Brackets

Model	Description	Dimensions
SMB1812SF 	• 12 mm swivel • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB1815SF 	• Swivel with set screws for mounting of T18 or T30 by its cable hub • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware and 3/64" hex wrench	
SMB18A 	• For use with M18, S18, S186ELD, T18 and Q25 Series sensors • 12-gauge, stainless steel, right angle mounting bracket with a curved mounting slot for versatility and orientation • Clearance for M4 (#8) hardware	
SMB18C 	• For use with S18, M18, T18 and Q25 Series sensors • 18 mm split clamp bracket • Black thermoplastic polyester • Includes stainless steel mounting hardware	
SMB18Q 	• Angled flanged mounting bracket for use with Q25 sensors	

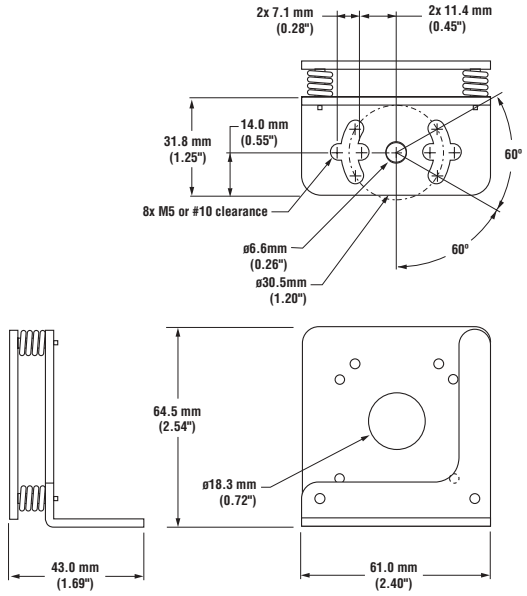
Mounting Brackets

Model	Description	Dimensions
SMB18SF 	• For use with M18, S18, T18 and Q25 Series sensors • 18 mm swivel bracket • Black thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB18UR 	• For use with M18, S18 and T18 Series sensors • 2-part universal rotating bracket • Stainless steel	
SMB3018SC 	• For use with S18, T18 and Q25 Series sensors • 18 mm swivel barrel or side mount bracket • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB30A 	• For use with S30, SM30, T30 and Q40 Series sensors • 12-gauge, stainless steel, right angle mounting bracket with a curved mounting slot for versatility and orientation • Clearance for M6 (1/4") hardware	

Mounting Brackets

Model	Description	Dimensions
SMB30C 	• For use with S30, SM30, T30 and Q40 Series sensors • 30 mm split clamp bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting hardware	
SMB30Q 	• For use with Q40 sensors • 30 mm angled flanged mounting bracket	
SMB30SC 	• For use with S30, SM30, T30 and Q40 Series sensors • 30 mm swivel bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting and swivel locking hardware	
SMB30SK 	• For use with S18, M18 and T18 Series sensors • Flat-mount swivel bracket with extended range of motion • Black reinforced thermoplastic polyester and 316 stainless steel • Includes stainless steel swivel locking hardware	

Mounting Brackets

Model	Description	Dimensions
SMB46A 	• For use with S186ELD Laser Emitter • 2-piece 12-gauge, stainless steel bracket assembly with precision sensor alignment adjustment • Includes 2 mm hex key	

NOTES:

QM42 Sensors

CE cULus

⚠ QM42 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

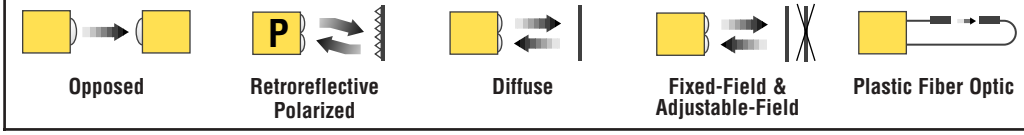
QM42 Sensors

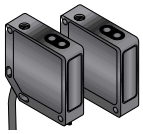
Self-Contained DC Photoelectric Sensors in Metal Housings

QMT42 cabled (left) and QM42 quick-disconnect (right)

- Available in opposed, polarized retroreflective, diffuse, fixed-field, adjustable-field, and plastic fiber optic sensing modes
- Fixed-field technology allow direct detection of objects within a defined sensing field, while ignoring reflective objects located beyond the sensing field cutoff point
- Long-range diffuse mode sensor have a powerful, collimated light source and special lensing which allows reliable long-range reflective sensing

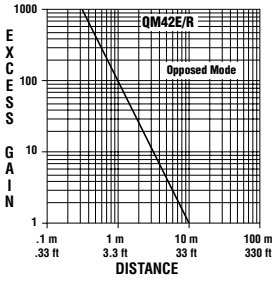
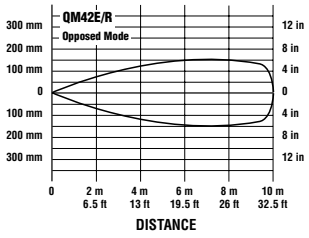
QM42 Sensing Mode Options





Infrared, 880 nm

QM42 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
QM426E **QM426EQ**	10 m (33')	2 m (6.5') 4-pin Euro QD	10-30V dc	—		Effective Beam: 8 mm 
QM42VN6R **QM42VN6RQ**		2 m (6.5') 4-pin Euro QD		NPN		
QM42VP6R **QM42VP6RQ**		2 m (6.5') 4-pin Euro QD		PNP		

For QM42 Sensors:

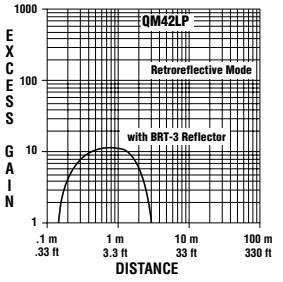
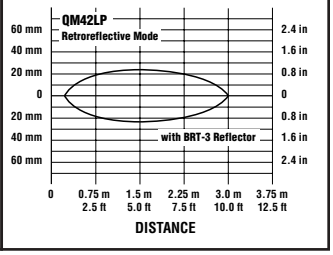
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **QM42VN6D W/30**)

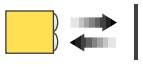
ii) A model with a QD connector requires an accessory mating cable. See pages 249 and the Accessories section for more information.

Visible red, 660 nm

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

QM42 Polarized Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
QM42VN6LP **QM42VN6LPQ**	3 m (10')	2 m (6.5') 4-pin Euro QD	10-30V dc	NPN		
QM42VP6LP **QM42VP6LPQ**		2 m (6.5') 4-pin Euro QD		PNP		

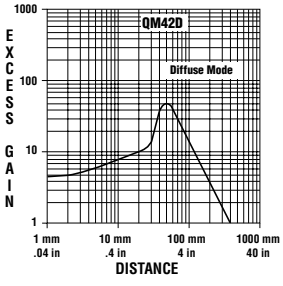
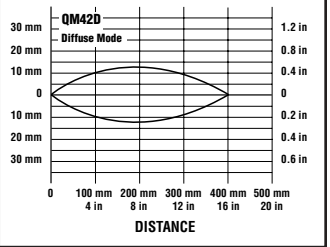
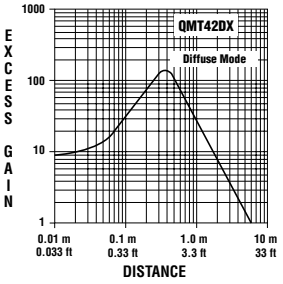
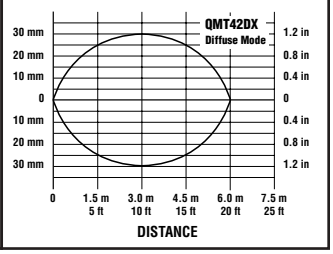


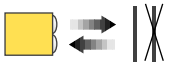
Infrared, 880 nm

Short-range

Long-range

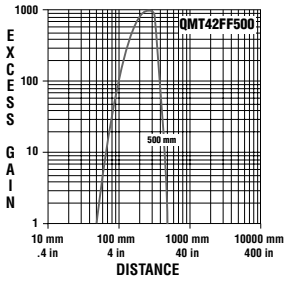
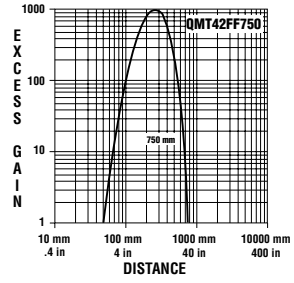
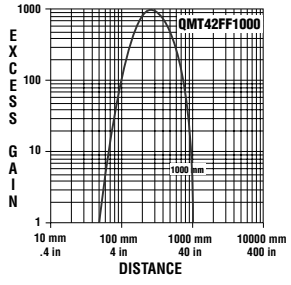
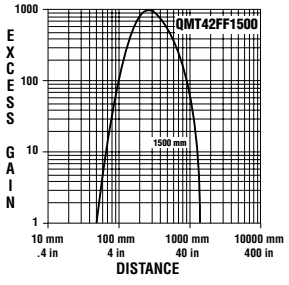
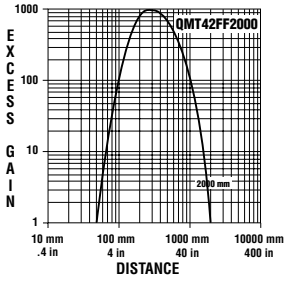
QM42 Diffuse Mode

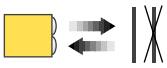
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Short-Range						
QM42VN6D **QM42VN6DQ**	400 mm (16")	2 m (6.5') 4-pin Euro QD	10-30V dc	NPN		
QM42VP6D **QM42VP6DQ**		2 m (6.5') 4-pin Euro QD		PNP		
Long-Range						
QMT42VN6DX **QMT42VN6DXQ**	10 mm (0.4") to 6 m (20')	2 m (6.5') 4-pin Euro QD	10-30V dc	NPN		
QMT42VP6DX **QMT42VP6DXQ**		2 m (6.5') 4-pin Euro QD		PNP		



Infrared, 880 nm

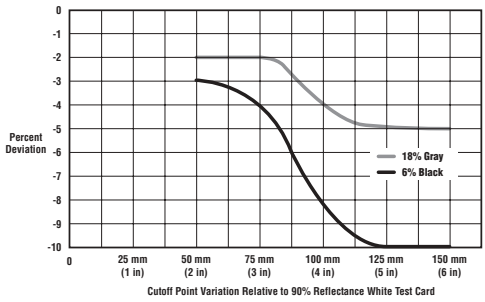
QMT42 Fixed-field Mode

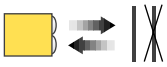
Models	Range	Cutoff Point	Cable	Supply Voltage	Output Type	Performance Curves
QMT42VN6FF500 QMT42VN6FF500Q	50 mm (2.0") to Cutoff point	500 mm (20")	2 m (6.5') 4-pin Euro QD	10-30V dc	NPN	
QMT42VP6FF500 QMT42VP6FF500Q			2 m (6.5') 4-pin Euro QD		PNP	
QMT42VN6FF750 QMT42VN6FF750Q		750 mm (30")	2 m (6.5') 4-pin Euro QD		NPN	
QMT42VP6FF750 QMT42VP6FF750Q			2 m (6.5') 4-pin Euro QD		PNP	
QMT42VN6FF1000 QMT42VN6FF1000Q		1000 mm (40")	2 m (6.5') 4-pin Euro QD		NPN	
QMT42VP6FF1000 QMT42VP6FF1000Q			2 m (6.5') 4-pin Euro QD		PNP	
QMT42VN6FF1500 QMT42VN6FF1500Q		1500 mm (60")	2 m (6.5') 4-pin Euro QD		NPN	
QMT42VP6FF1500 QMT42VP6FF1500Q			2 m (6.5') 4-pin Euro QD		PNP	
QMT42VN6FF2000 QMT42VN6FF2000Q		2000 mm (79")	2 m (6.5') 4-pin Euro QD		NPN	
QMT42VP6FF2000 QMT42VP6FF2000Q			2 m (6.5') 4-pin Euro QD		PNP	



Visible Red, 680 nm

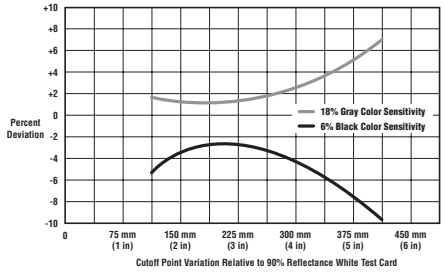
QM42 Short Range Adjustable Field - 150 mm

Models	Range	Cutoff Point	Cable	Supply Voltage	Output Type	Cutoff Point Deviation
QM42VN6AFV150 QM42VN6AFV150Q	5 mm (0.2") to Cutoff point	50 to 150 mm (2 to 6")	2 m (6.5') 4-pin Euro QD	10-30V dc	NPN	
QM42VP6AFV150 QM42VP6AFV150Q			2 m (6.5') 4-pin Euro QD		PNP	



Visible Red, 680 nm

QMT42 Long Range Adjustable Field - 400 mm

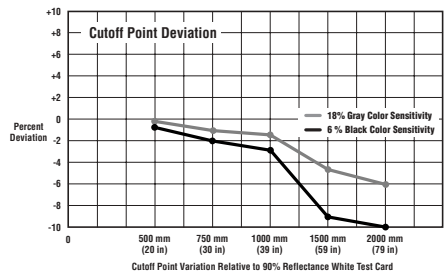
Models	Range	Cutoff Point	Cable	Supply Voltage	Output Type	Cutoff Point Deviation
QMT42VN6AFV400 QMT42VN6AFV400Q	25 mm (1") to Cutoff point	125 to 400 mm (5 to 16")	2 m (6.5') 4-pin Euro QD	10-30V dc	NPN	
QMT42VP6AFV400 QMT42VP6AFV400Q			2 m (6.5') 4-pin Euro QD		PNP	

Interpretation of Performance Curves for Adjustable Field Models

The percentage of deviation indicates a change in the cutoff point for either 18% gray or 6% black targets, relative to the cutoff point set for a 90% reflective white test card.

As an example, the cutoff point decreases 10% for a 6% reflectance black target when the cutoff point is adjusted for 400 mm (16") using a 90% reflectance white test card. In other words, for the QMT42 Long Range Adjustable Field models, the cutoff point for the black target is 360 mm (14") for this setting.

Interpretation of Cutoff Point Deviation Curve for Fixed-field Models

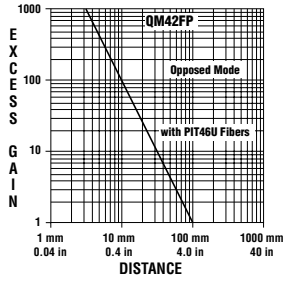
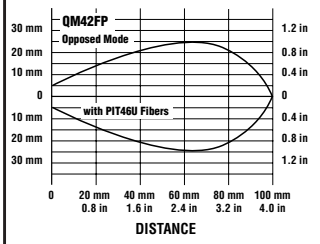
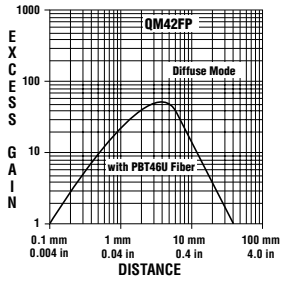
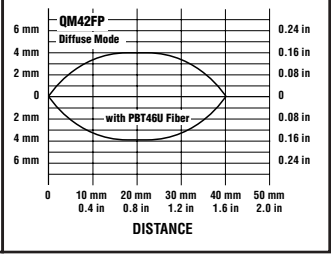


The percentage of deviation indicates a change in the cutoff point for either 18% gray or 6% black targets, relative to the cutoff point for a 90% reflective white test card.

As an example, the cutoff point decreases 10% for a 6% reflectance black target when the cutoff point is 2000 mm (79") using a 90% reflectance white test card. In other words, the cutoff point for the black target is 1800 mm (71").

Visible red, 660 nm

QM42 Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
QM42VN6FP **QM42VN6FPQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-pin Euro QD	10-30V dc	NPN		
QM42VP6FP **QM42VP6FPQ**		2 m (6.5') 4-pin Euro QD		PNP		

For QM42 Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **QM42VP6FP W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 249 and the Accessories section for more information.

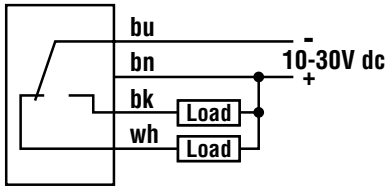
QM42 Specifications

Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than: Opposed mode: 30 milliamps (emitter), 10 milliamps (receiver) Short-range diffuse and retroreflective models: 20 milliamps Fiber optic models: 30 milliamps Adjustable-field models: 50 milliamps Fixed-field and long-range diffuse models: 40 milliamps
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	SPDT (complementary) solid-state dc switch; Choose NPN (current sinking) or PNP (current sourcing) models. *Light operate:* N.O. output conducts when the sensor sees its own (or the emitter's) modulated light *Dark operate:* N.C. output conducts when the sensor sees dark
Output Rating	100 mA maximum (each output) **Off-state leakage current:** <5 microamps at 30V dc; **On-state saturation voltage:** <1V at 10 mA dc; <1.5V at 100 mA dc
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs Overload trip point ≥150 mA, typical, at 20ºC
Output Response Time	**Opposed:** 1 millisecond on, 0.5 millisecond off; **Diffuse, Retro and Adjustable- and fixed-field:** 1 millisecond on and off; **Plastic Fiber Optic**: 0.25 millisecond on and off NOTE: 100 millisecond delay on power-up; outputs are non-conducting during this time.
Repeatability	**Opposed:** 120 microseconds; **Diffuse, Retro and Adjustable- and Fixed-field:** 250 microseconds; **Fiber Optic:** 60 microseconds. Repeatability and response are independent of signal strength
Sensing Hysteresis	**For Long-range Diffuse models:** less than 20% of set sensing distance **For Adjustable-field models:** less than 7% of set cutoff distance **For Fixed-field models:** 2000 mm models - less than 5% of set cutoff distance 1500 mm models - less than 4% of set cutoff distance 1000 mm models - less than 3% of set cutoff distance 750 mm models - less than 2% of set cutoff distance 500 mm models - less than 1% of set cutoff distance
Cutoff Point Tolerance	For Fixed-field models only: ±10% of nominal cutoff distance
Adjustments	All models except emitters and Adjustable- and fixed-field and Long-range diffuse: 15-turn slotted brass GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel) **150 mm Adjustable-field:** 12-turn slotted brass cutoff distance adjustment potentiometer (clutched at both ends of travel) **400 mm Adjustable-field:** 15-turn slotted brass cutoff distance adjustment potentiometer (clutched at both ends of travel) **Long-range diffuse**: 4-turn slotted GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel) Fixed-field: No adjustments
Indicators	Two LEDs: Green and Yellow GREEN **glowing steadily** = power to sensor is ON — Opposed emitters: Green power ON GREEN **flashing** = output is overloaded YELLOW **glowing steadily** = light is sensed; normally open output ON YELLOW **flashing** = marginal excess gain (1-1.5x) in light condition
Construction	Housings are die-cast zinc alloy with black acrylic polyurethane finish; lenses are acrylic
Environmental Rating	IP67; NEMA 6
Connections	2 m (6.5') or 9 m (30') attached cable, or 4-pin euro-style quick-disconnect fitting. QD cables are ordered separately. See page 249 and Accessories section.
Operating Conditions	**Temperature for Long-range Diffuse, Adjustable Field and Fixed-field models:** -20° to +55°C (-4° to 131°F) **Temperature for all other models:** -20° to +70°C (-7° to 158ºF) **Maximum Relative Humidity:** 90% at 50°C (non-condensing)
Certifications	CE Except Fixed-field models – Approvals in process c UL us

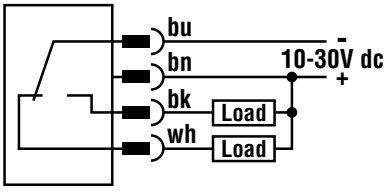
QM42 Hookup Diagrams

Sensors with NPN (Sinking) Outputs

Cabled Models

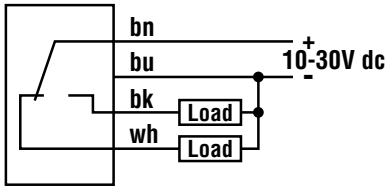


Quick-Disconnect Models

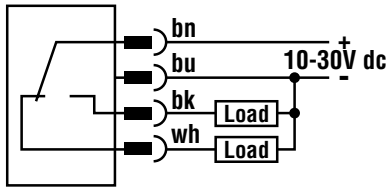


Sensors with PNP (Sourcing) Outputs

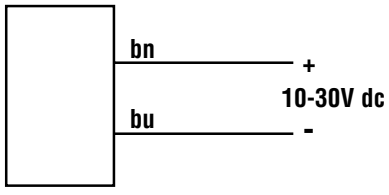
Cabled Models



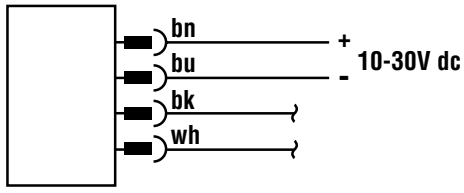
Quick-Disconnect Models



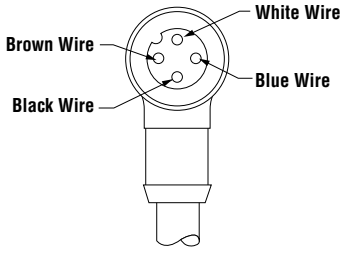
DC Emitters with Attached Cable



DC Emitters with Quick-Disconnect



4-Pin Euro-Style Pin-out (Cable Connector Shown)



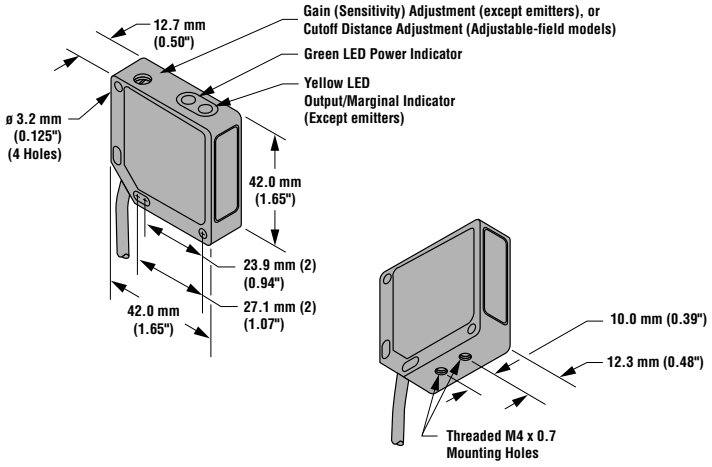
Quick-Disconnect (QD) Option

QM42 sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable or with a 4-pin euro-style QD cable fitting. QM42 QD sensors are identified by the letter “Q” in their model number suffix. Information on mating cables for QM42 QD sensors can be found on page 249 and in the Accessories section. Cables are supplied in a standard length of 2 m (6.5').

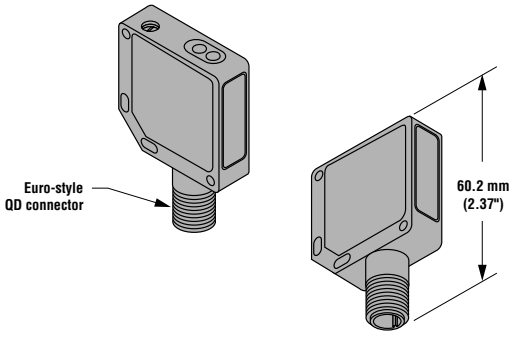
QM42 and QMT42 Dimensions

QM42 Opposed, Retro, Short-Range Diffuse & Short-Range Adjustable-Field Sensing Modes (model suffix E, R, LP, D & AFV150)

Cabled Models

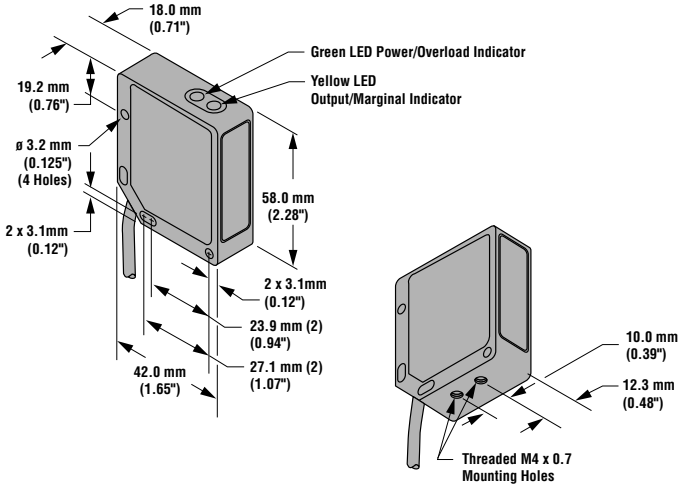


Quick-Disconnect Models

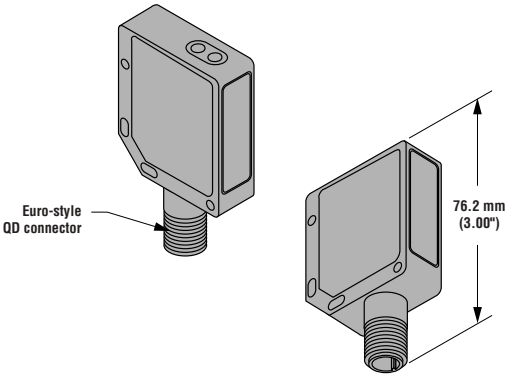


QMT42 Long-Range Diffuse Sensing Mode (model suffix DX)

Cabled Models



Quick-Disconnect Models

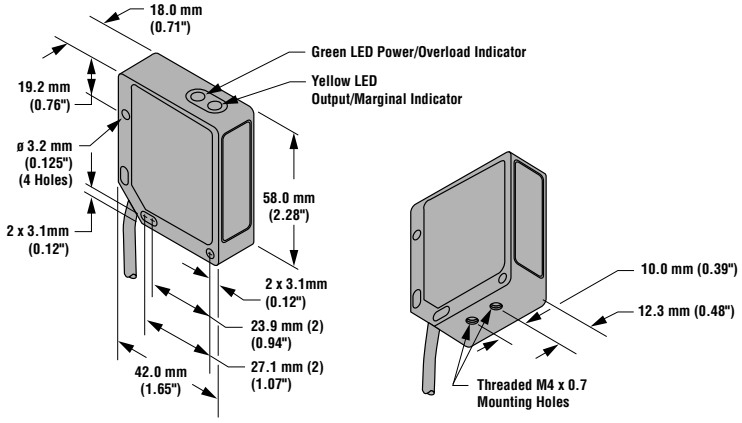


QMT42 - Rear View

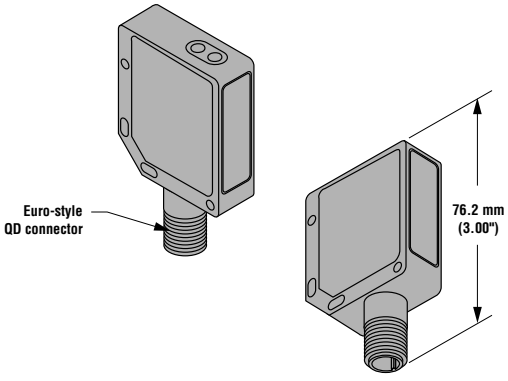
QM42 and QMT42 Dimensions

QMT42 Fixed-Field Sensing Mode (model suffix FF)

Cabled Models

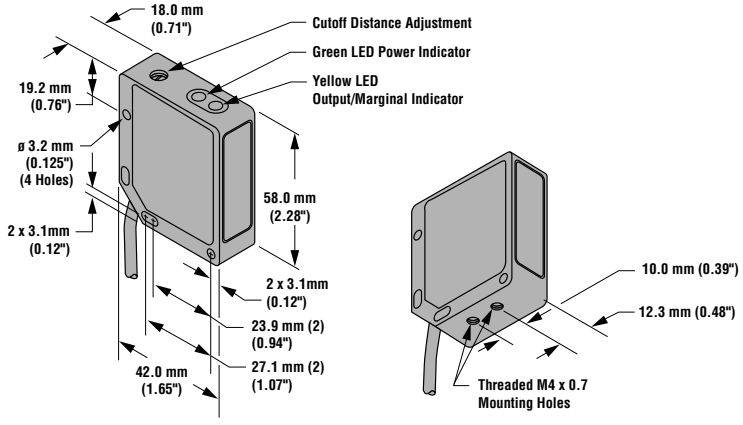


Quick-Disconnect Models

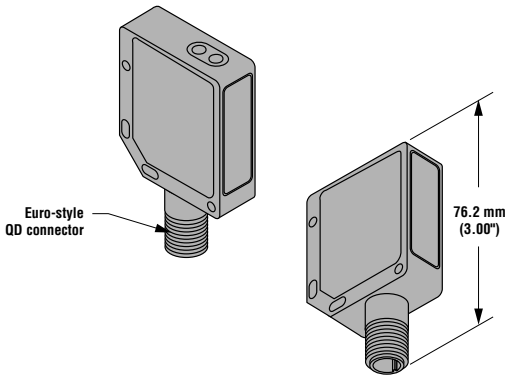


QMT42 Adjustable-field Sensing Mode (model suffix AFV400)

Cabled Models

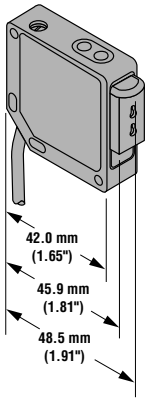


Quick-Disconnect Models

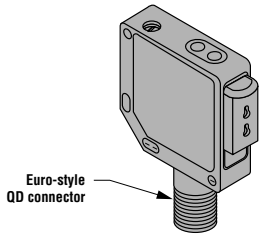


QM42 Plastic Fiber Optic Sensing Mode (model suffix FP)

Cabled Models



Quick-Disconnect Models



Modifications

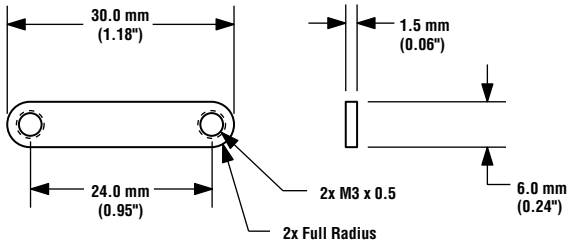
Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All QM42 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	QM42VN6D W/30

Quick-Disconnect (QD) Cables

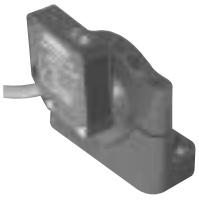
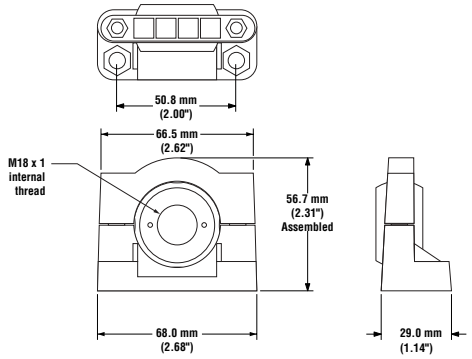
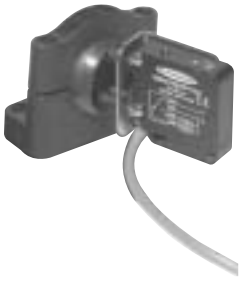
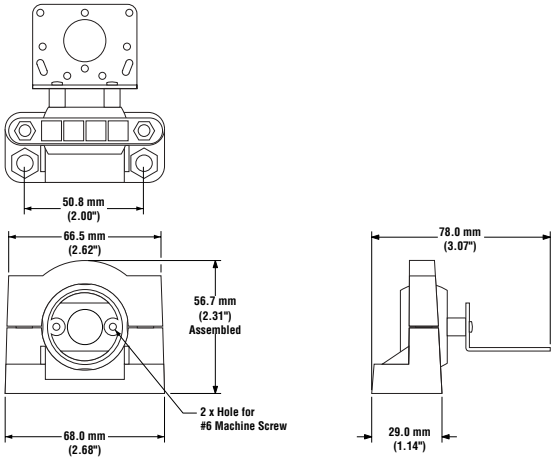
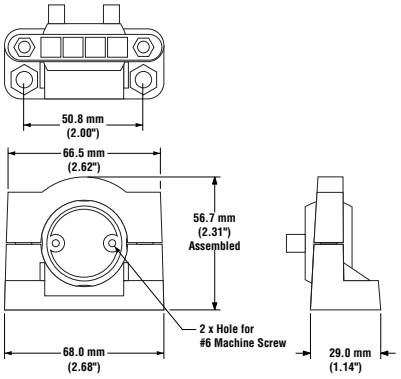
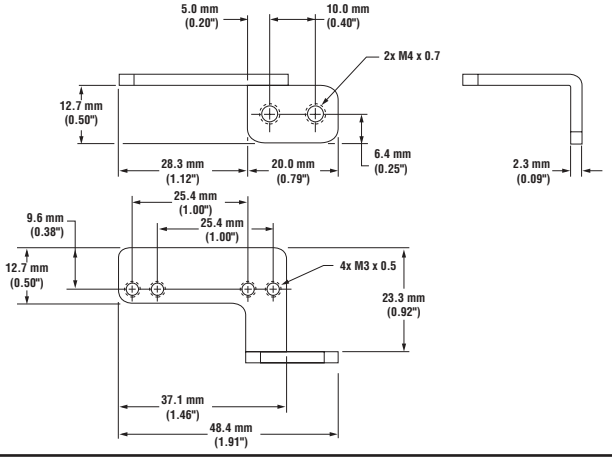
Following is the selection of cables available for QM42 QD models. See the Accessories section for more cable information.

Style	Model	Length	Connector	Used with:
4-Pin Euro	**MQDC-406**	2 m (6.5')	Straight	All QM42 sensors with QD fitting
	MQDC-415	5 m (15')	Straight	
	MQDC-430	9 m (30')	Straight	
	MQDC-406RA	2 m (6.5')	Right-angle	
	MQDC-415RA	5 m (15')	Right-angle	
	MQDC-430RA	9 m (30')	Right-angle	

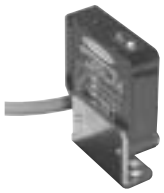
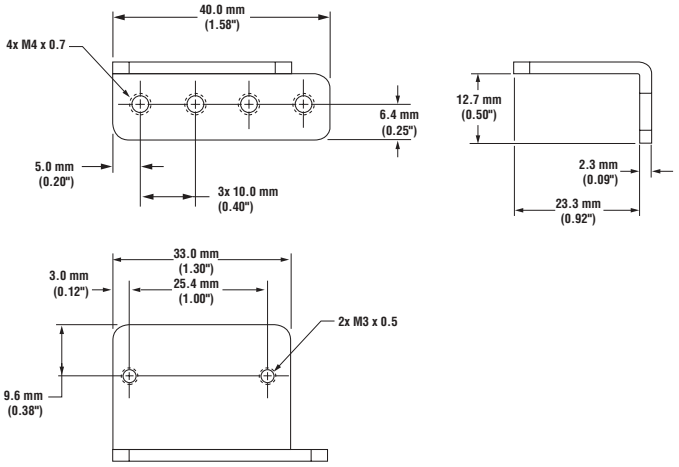
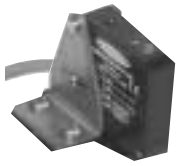
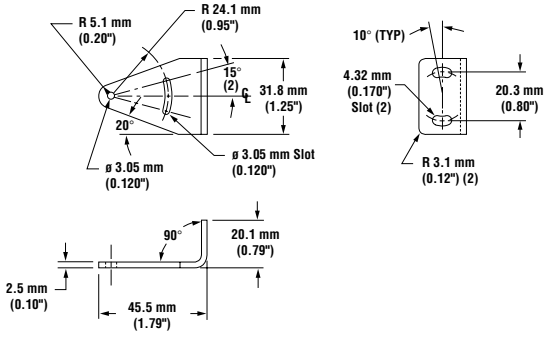
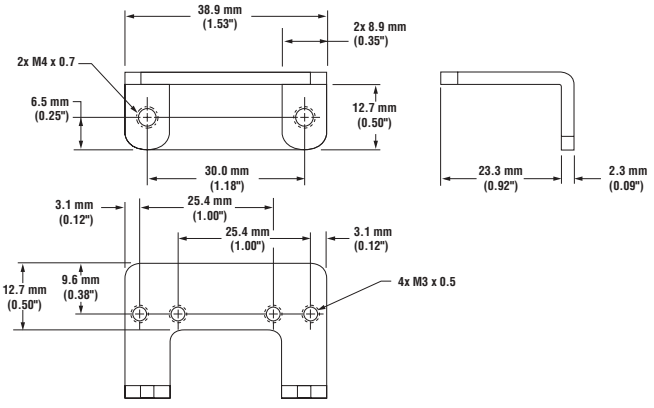
Mounting Brackets

Model	Description	Dimensions
SMH241F Nut Plate 	• Nut strap replaces two M3 mounting nuts and washers • 16-gauge stainless steel	

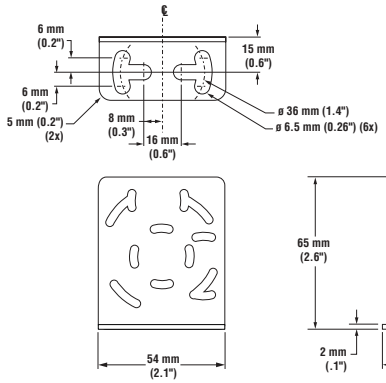
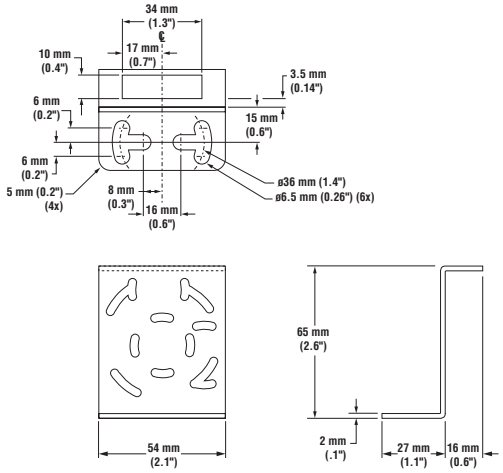
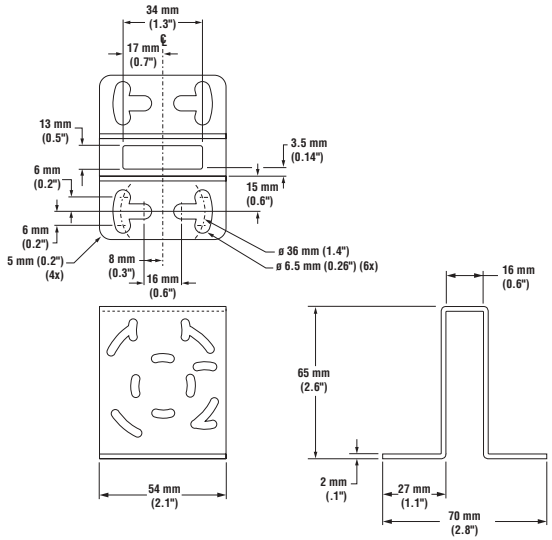
Mounting Brackets

Model	Description	Dimensions
SMB3018SC 	• 18 mm swivel side mount bracket • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB30SK 	• Flat-mount swivel bracket with extended range of motion • Black reinforced thermoplastic polyester and 316 stainless steel • Includes stainless steel swivel locking hardware	
SMB30SUS 	• Side mount swivel bracket – extended range of motion • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB42F 	• 13-gauge stainless steel • Includes mounting hardware	

Mounting Brackets

Model	Description	Dimensions
SMB42L 	• 13-gauge stainless steel • Includes mounting hardware	
SMB42T 	• 2-axis side mounting bracket • Stainless steel • Includes M3 sensor mounting hardware	
SMB42U 	• 13-gauge stainless steel • Includes mounting hardware	

Mounting Brackets

Model	Description	Dimensions
SMB46L 	• "L" bracket • 14-gauge 316 stainless steel	
SMB46S 	• "S" bracket • 14-gauge 316 stainless steel	
SMB46U 	• "U" bracket • 14-gauge 316 stainless steel	

PicoDot® Sensors

CAUTION . . .

Never stare directly into the emitter lens. Laser light can damage your eyes. Avoid placing any mirror-like object in the beam. Never use a mirror as a target.

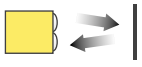
PicoDot® sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

PicoDot® Laser Sensors

- Visible red, Class 2 sensors
- 200 microsecond sensing response
- Convergent beam models with precise, high-energy sensing spot at focus available in three focal lengths: 50 mm (2"), 100 mm (4") and 200 mm (8")
- Retroreflective mode models with precise, narrow beam; excellent for sensing the presence of tiny parts at close range, small parts at medium ranges and for accurate sensing over long distances
- Models available with compact light weight housings or with environmentally sealed housings
- 10 to 30V dc operation; choice of NPN (sinking) or PNP (sourcing) complementary solid-state output

CAUTION . . .
Never stare directly into the emitter lens. Laser light can damage your eyes. Avoid placing any mirror-like object in the beam. Never use a mirror as a target.

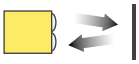
PicoDot Sensing Mode Options



Convergent

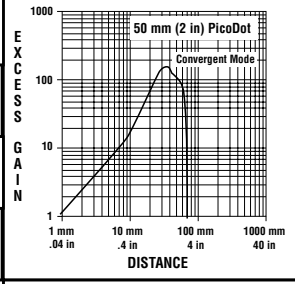
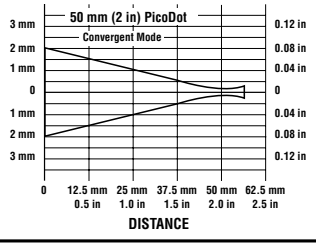
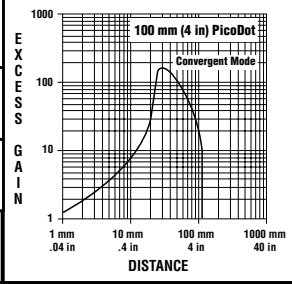
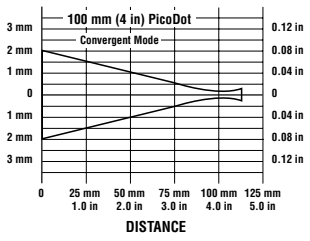
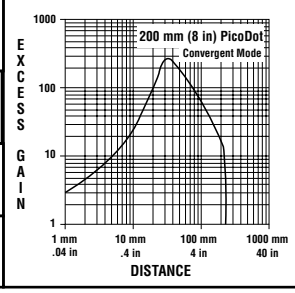
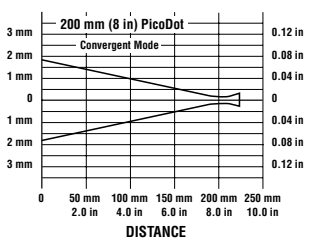
Polarized Retroreflective

Choose PD49 models for environmentally sealed housing
Choose PD45 models for compact light weight housing



Visible red; Class 2 laser; 650 nm

PicoDot Convergent Laser Mode

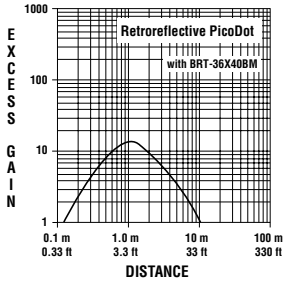
Models	Focus	Cable	Supply Voltage	Output Type	Housing Rating	Excess Gain	Beam Width
						Performance based on 90% reflectance white test card	
PD45VN6C50 **PD45VN6C50Q**	50 mm (2.0") Spot Size at Focus: 0.25 mm (0.01")	2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	NPN	IP54, NEMA 3		
PD49VN6C50 **PD49VN6C50Q**		2 m (6.5') 5-pin Euro QD pigtail			IP67, NEMA 6		
PD45VP6C50 **PD45VP6C50Q**		2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	PNP	IP54, NEMA 3		
PD49VP6C50 **PD49VP6C50Q**		2 m (6.5') 5-pin Euro QD pigtail			IP67, NEMA 6		
PD45VN6C100 **PD45VN6C100Q**	102 mm (4.0") Spot Size at Focus: 0.25 mm (0.01")	2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	NPN	IP54, NEMA 3		
PD49VN6C100 **PD49VN6C100Q**		2 m (6.5') 5-pin Euro QD pigtail			IP67, NEMA 6		
PD45VP6C100 **PD45VP6C100Q**		2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	PNP	IP54, NEMA 3		
PD49VP6C100 **PD49VP6C100Q**		2 m (6.5') 5-pin Euro QD pigtail			IP67, NEMA 6		
PD45VN6C200 **PD45VN6C200Q**	203 mm (8.0") Spot Size at Focus: 0.25 mm (0.01")	2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	NPN	IP54, NEMA 3		
PD49VN6C200 **PD49VN6C200Q**		2 m (6.5') 5-pin Euro QD pigtail			IP67, NEMA 6		
PD45VP6C200 **PD45VP6C200Q**		2 m (6.5') 5-pin Euro QD pigtail	10-30V dc	PNP	IP54, NEMA 3		
PD49VP6C200 **PD49VP6C200Q**		2 m (6.5') 5-pin Euro QD pigtail			IP67, NEMA 6		

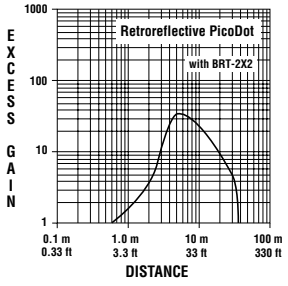
Visible red; Class 2 laser; 670 nm

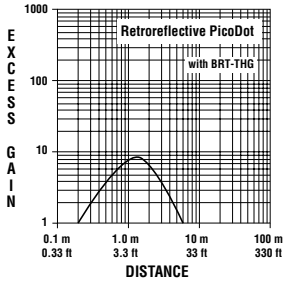
Choose PD49 models for environmentally sealed housing
Choose PD45 models for compact light weight housing

PicoDot Polarized Retroreflective Laser Mode

Models	Range*	Cable	Supply Voltage	Output Type	Housing Rating	Excess Gain
PD45VN6LLP	0.2 m to 10.6 m (8" to 35')	2 m (6.5')	10-30V dc	NPN	IP54, NEMA 3	With BRT-36X40BM reflector included with sensor
PD45VN6LLPQ		5-pin Euro QD pigtail				
PD49VN6LLP		2 m (6.5')			IP67, NEMA 6	
PD49VN6LLPQ		5-pin Euro QD pigtail				With optional BRT-2X2 reflector. See p. 726 for reflector dimensions.
PD45VP6LLP		2 m (6.5')		PNP	IP54, NEMA 3	
PD45VP6LLPQ		5-pin Euro QD pigtail				With optional BRT-THG tape
PD49VP6LLP		2 m (6.5')			IP67, NEMA 6	
PD49VP6LLPQ		5-pin Euro QD pigtail				







* Tested using a BRT-36X40BM retro target (included with each sensor). Actual range depends on the efficiency and size of the retroreflective target. See Accessories section for retro target information.

For PicoDot Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **PD45VN6C100 W/30**)

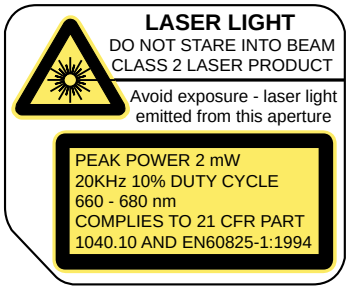
ii) Pigtail QD connectors are 150 mm (6") long

iii) A model with a QD connector requires an accessory mating cable. See page 259 and the Accessories section for more information.

PicoDot Specifications

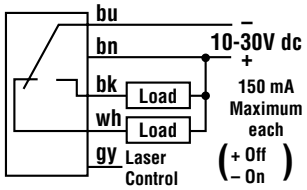
Sensing Beam	Visible red Class 2 laser; 650 nm
Supply Voltage	10 to 30V dc (10% maximum ripple) at less than 20 milliamps, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity, over voltage, and transient voltages
Output Configuration	SPDT (complementary) solid-state switch; Choose NPN (current sinking) or PNP (current sourcing) models Light operate: Normally-open output conducts when the sensor sees its own modulated light Dark operate: Normally-closed output conducts when the sensor sees dark
Output Rating	150 mA maximum (each output) **Off-state leakage current** <1 microamp at 30V dc; **On-state saturation voltage** <0.3V at 10 mA dc; <0.8V at 150 mA dc
Output Protection	Protected against continuous overload or short-circuit of outputs; Overload trip point ≥ 220 milliamps
Output Response Time	0.2 milliseconds (200 microseconds) “ON” and “OFF”
Repeatability	50 microseconds
Adjustments	12-turn GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel)
Extinguishing Wire	Gray wire held “low” for laser operation; “high” to turn laser off; Low = ≤1.0V dc; High = ≥+V-4.0V dc (<30V dc) or disconnect wire
Indicators	Two LEDs: Green and Yellow GREEN **glowing steadily** = power to sensor is “ON” YELLOW **glowing steadily** = light is sensed; normally open output is conducting GREEN **Blinking** = power overloaded YELLOW **Blinking** = marginal return signal
Construction	Housings are Cycolac® KJB heat-resistant ABS, UL94-VO rated; acrylic lens
Environmental Rating	**PD45 models:** NEMA 3; IEC IP54 **PD49 models:** NEMA 6; IEC IP67
Connections	2 m (6.5') or 9 m (30') attached cable, or 5-pin euro-style 150 mm (6") pigtail quick-disconnect fitting; mating cables for QD models are ordered separately. See page 259.
Operating Conditions	**Temperature:** -10° to +45°C (+14° to 113°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Weight	**PD45 models:** sensor only: 22g (0.8 oz); sensor plus 2 m cable: 62g (2.2 oz) **PD49 models:** sensor only 28g (1 oz); sensor plus 2 m cable: 68g (2.4 oz)
Application Notes	False pulse may occur <1 second after power-up
Certifications	CE certification for some models is in process. Contact factory for approval status.

Cycolac® is a registered trademark of Borg-Warner

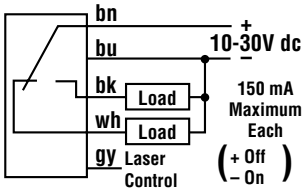


PicoDot Hookup Diagrams

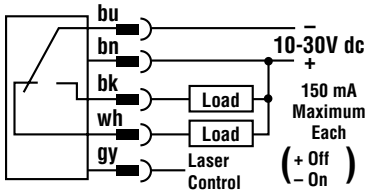
Sensors with NPN (Sinking) Outputs with Attached Cable



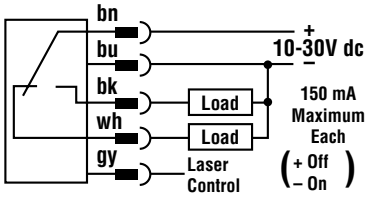
Sensors with PNP (Sourcing) Outputs with Attached Cable



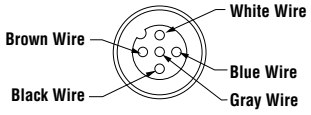
Sensors with NPN (Sinking) Outputs with Quick-Disconnect



Sensors with PNP (Sourcing) Outputs with Quick-Disconnect



5-Pin Euro-Style Pin-out (Cable Connector Shown)

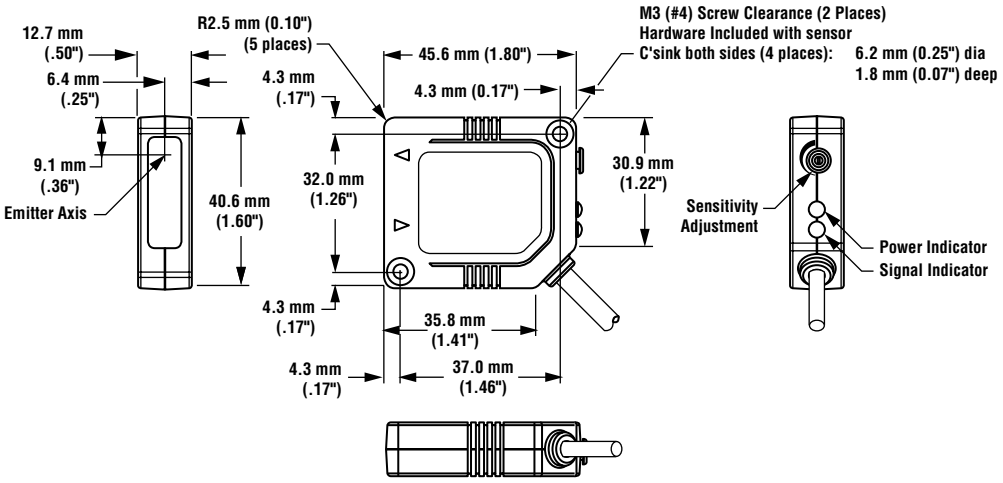


Quick-Disconnect (QD) Option

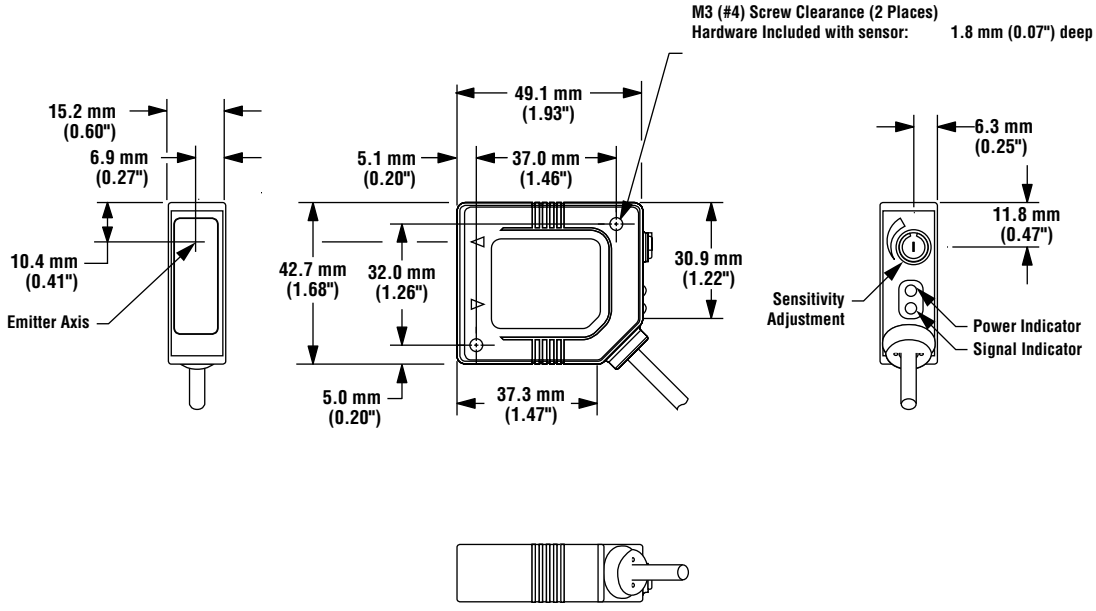
PicoDot sensors are sold with either a 2 m (6.5') attached PVC-covered cable, or with a 5-pin euro-style pigtail QD cable fitting.

PicoDot QD sensors are identified by the letter “Q” in their model number suffix. Mating cables for QD PicoDot sensors are model MQDC1-5xx (straight connector) or MQDC1-5xxRA (right-angled connector). For more information on QD cables see page 259 or Accessories section.

PicoDot PD45 (IP54, NEMA 3) Series Dimensions



PicoDot PD49 (IP67, NEMA 6) Series Dimensions

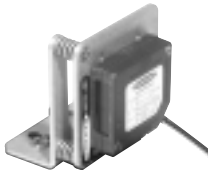
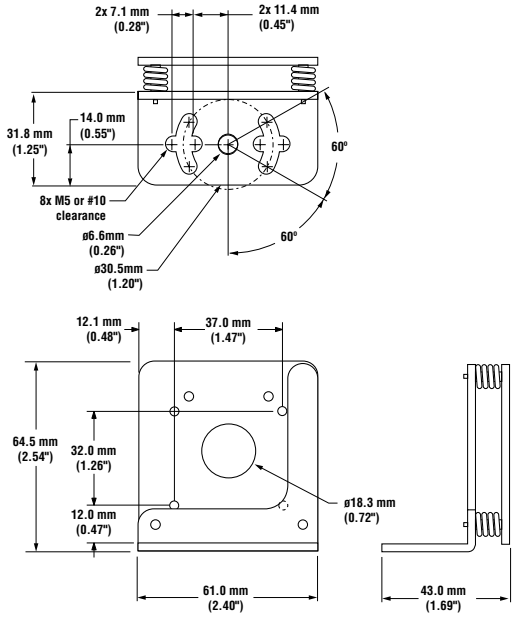
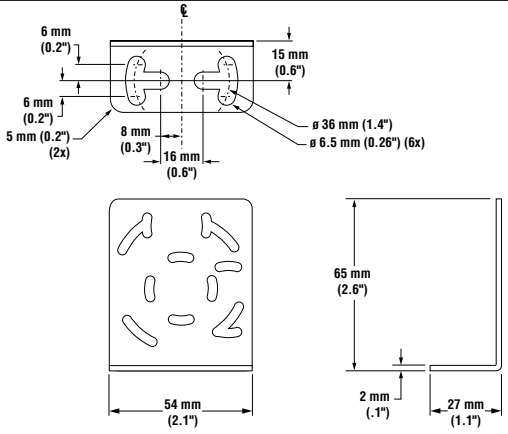


Quick-Disconnect (QD) Cables

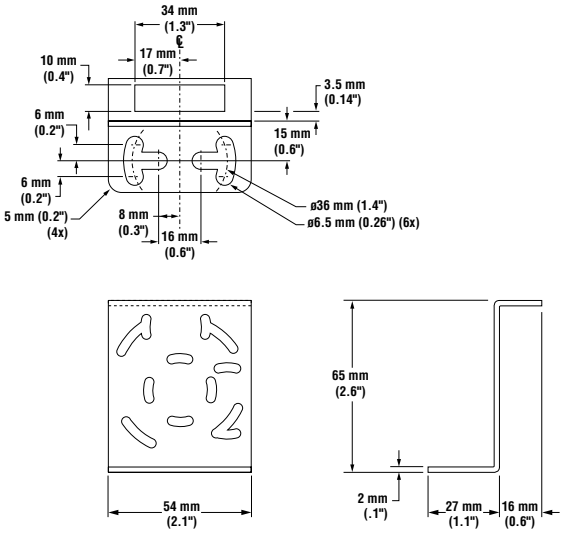
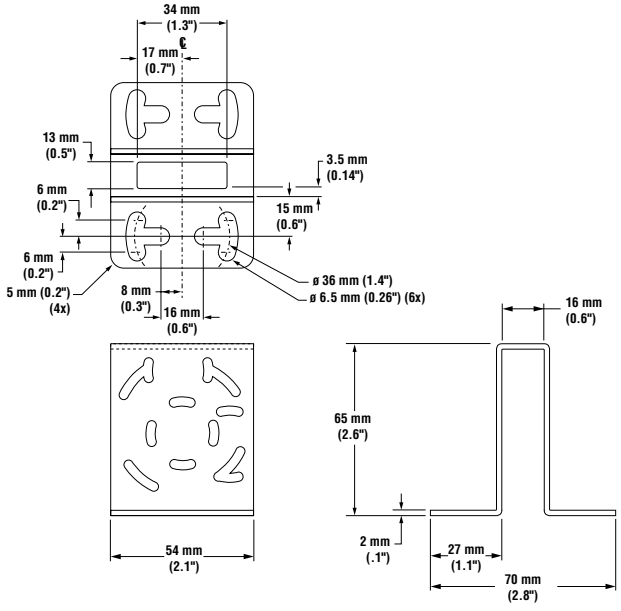
Following is the selection of cables available for PicoDot QD models. See the Accessories section for more cable information.

Style	Model	Length	Connector	Used with:
5-Pin Euro	**MQDC1-506** **MQDC1-515** **MQDC1-530**	2 m (6.5') 5 m (15') 9 m (30')	Straight	All PicoDot sensors with QD fitting

Mounting Brackets

Model	Description	Dimensions
SMB46A 	• Stainless steel adjustable bracket • Comes with 2 mm shortarm hex keys	
SMB46L 	• "L" bracket • 14-gauge 316 stainless steel	

Mounting Brackets

Model	Description	Dimensions
SMB46S 	• “S” bracket • 14-gauge 316 stainless steel	
SMB46U 	• “U” bracket • 14-gauge 316 stainless steel	

Q50 Sensors

Q50 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

L-GAGE Q50 SENSORS

LED-Based Linear Displacement Sensor with Analog Output and TEACH-mode Programming

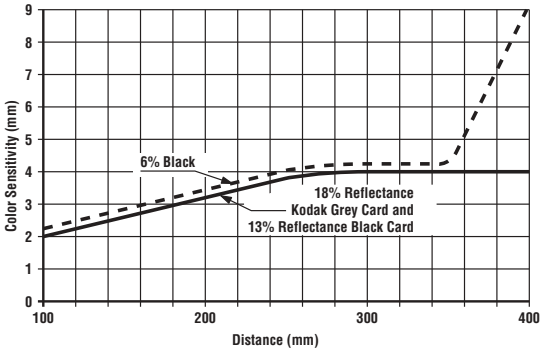
- Fast, easy-to-use TEACH-Mode programming; no potentiometer adjustments
- Selectable output response speeds: 4 milliseconds or 64 milliseconds (see hookup)
- Teach a sensing window size and position, or a set-point threshold centered within a 100 mm window
- Two sensing ranges, depending on model: 100 to 300 mm (visible red beam models), and 100 to 400 mm (infrared beam models)
- Sensor linearity is better than 3 mm
- Banner's patented scalable analog output (U.S. patent #6,122,039) automatically distributes the output signal over the width of the programmed sensing window
- Analog output slope can be either positive or negative, depending upon which window limit is programmed first
- Two bicolor Status LEDs
- Choose 2 m or 9 m unterminated cable, or swivel 5-pin Euro-style QD connector
- Rugged construction withstands demanding sensing environments; rated IEC IP67, NEMA 6
- Select models with either visible red or infrared beam
- Select models with either a 0-10V or 4-20 mA output

L-GAGE Q50 Analog Output Sensor Models

Models	Range	Cable*	Supply Voltage	Beam	Output	Response Time
Q50BVI	100 to 300 mm (3.9" to 11.8")	5-wire, 2 m (6.5') cable	15 to 30V dc	Visible Red LED	4 to 20 mA	Fast Speed: 4 ms Slow Speed: 64 ms
Q50BVIQ		5-pin Euro-style QD				
Q50BVU		5-wire, 2 m (6.5') cable			0 to 10V	
Q50BVUQ		5-pin Euro-style QD				
Q50BI	100 to 400 mm (3.9" to 15.7")	5-wire, 2 m (6.5') cable		Infrared LED	4 to 20 mA	
Q50BIQ		5-pin Euro-style QD				
Q50BU		5-wire, 2 m (6.5') cable			0 to 10V	
Q50BUQ		5-pin Euro-style QD				

* 9 m cables are available by adding suffix "**W/30**" to the model number of any cabled sensor (e.g., **Q50BVI W/30**). A model with a QD connector requires a mating cable; see page 265 or the Accessories section.

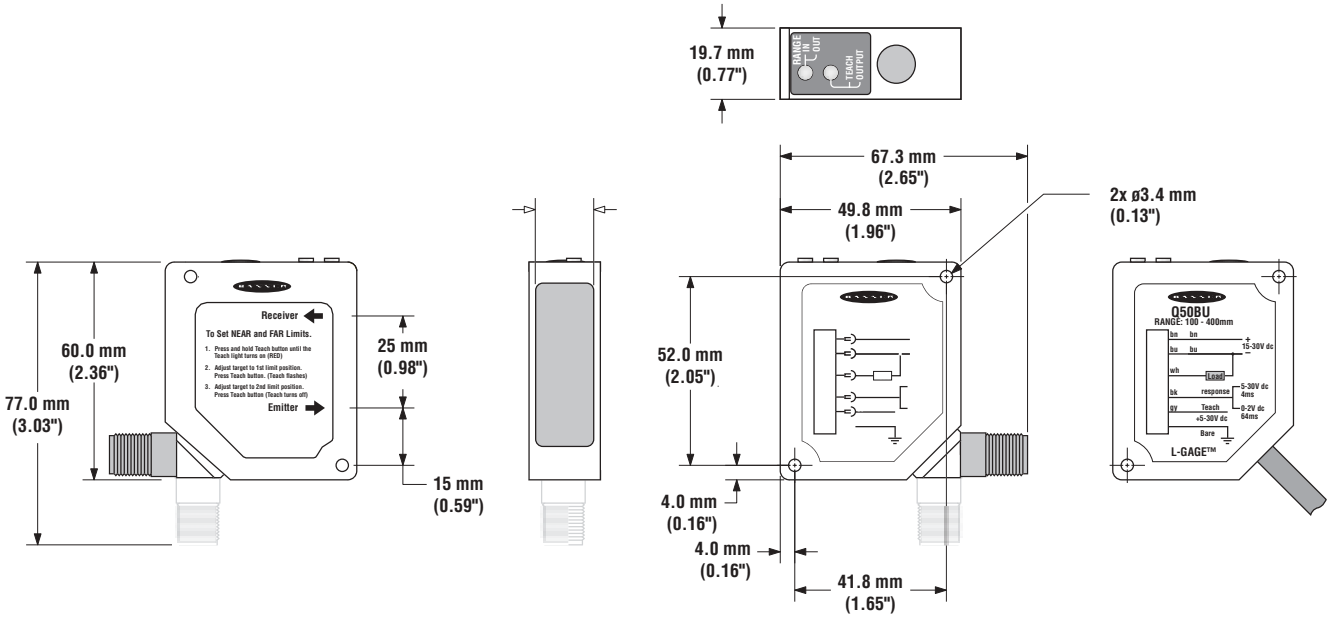
L-GAGE Q50 Analog Output Sensor Specifications

Sensing Range	**Q50BV:** 100 to 300 mm (3.9" to 11.8")	**Q50B:** 100 to 400 mm (3.9" to 15.7")
Supply Voltage	15 to 30V dc (10% maximum ripple); 70 mA max. (exclusive of load)	
Supply Protection Circuitry	Protected against reverse polarity and transient overvoltages	
Delay at Power-up	2 seconds	
Sensing Beam	**Wave length** **Q50BV:** 685 nm (typical) **Q50B:** 880 nm (typical) **Beam Size** **Q50BV:** 20 mm dia. (max.) **Q50B:** 20 mm dia. (max.)	
Output Configuration	**Depending on model** **4-20 mA current sourcing models:** 1 kΩ max. load @ 24V dc. Max. load = [(V_{CC} -4.5)/0.02]Ω Loss of signal or target outside of sensor range: 3.6 mA **0-10V voltage sourcing models:** 15 mA max. Loss of signal or target outside of sensor range: 0V	
Output Protection	Protected against short circuit conditions	
Output Response Time	**Analog Output** / **Average Interval** / **Update Rate** / **-3 dB Frequency Response** **Fast:** 4 ms 1 ms 112 Hz **Slow:** 64 ms 4 ms 7 Hz	
Resolution	**Target Distance:** 200 mm **Slow Response:** 1 mm max. **Fast Response:** 4 mm max.	
Linearity	±3 mm	
Color Sensitivity (typical)		L-GAGE Q50 color sensitivity (This represents the expected change in output when the target color is changed from a 90% reflectance Kodak White Card to a 6%, 13% or 18% reflectance surface.) NOTES: Color sensitivity is independent of response time Q50B (infrared models) span is 100-400 mm Q50BV (visible red models) span is 100-300 mm
Temperature Drift	**From 0° to 50°C:** -0.25 mm/°C **From -10° to 55°C:** -0.35 mm/°C	
Remote and Speed Input Impedance	15 kΩ	
Remote Teach Input	**To Teach:** Connect gray wire to +5 to 30V dc **To Disable:** Connect gray wire to 0 to +2V dc (or open connection)	
Adjustments	**Response Speed:** **Fast Speed:** Connect black wire to +5 to 30V dc **Slow Speed:** Connect black wire to 0 to +2V dc (or open connection)	
Indicators	**Range LED Indicator (green/red)** Green — Target is within sensing range Red — Target is outside sensing range OFF — Sensor Power OFF **Teach/Output LED Indicator (yellow/red)** Yellow — Target is within taught window limits OFF — Target is outside taught window limits Red — Sensor is in TEACH mode	
Minimum Taught Window	**Target distance at 300 mm:** 50 mm window **Target distance at 125 mm:** 10 mm window	
Ambient Light Immunity	<10,000 Lux	

L-GAGE Q50 Analog Output Sensor Specifications (continued)

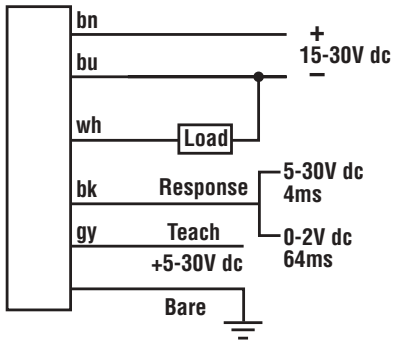
Construction	**Housing:** Molded ABS/Polycarbonate M3 mounting hardware is supplied **Window Lens:** Acrylic
Environmental Rating	IEC IP67, NEMA 6
Connections	2 m or 9 m 5-conductor PVC-covered attached cable or 5-pin Euro-style quick disconnect
Operating Conditions	**Temperature:** -10° to +55°C (+14° to +131°F) **Max. Rel. Humidity:** 90% at +50°C (non-condensing)
Vibration and Mechanical Shock	All models meet Mil. Std. 202F requirements. Method 201A (Vibration: 10 to 60Hz max. double amplitude 0.06", maximum acceleration 10G). Also meets IEC 947-5-2 requirements: 30G, 11 ms duration, half sine wave.
Application Notes	Allow 15-minute warm-up for maximum linearity.

L-GAGE Q50 Dimensions

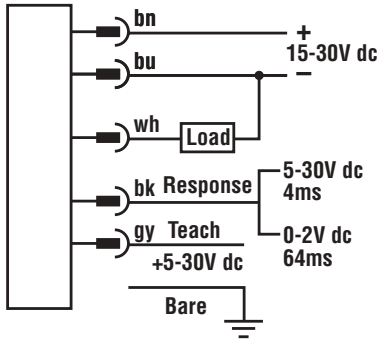


L-GAGE Q50 Hookups

Cable Models



Quick-Disconnect Models

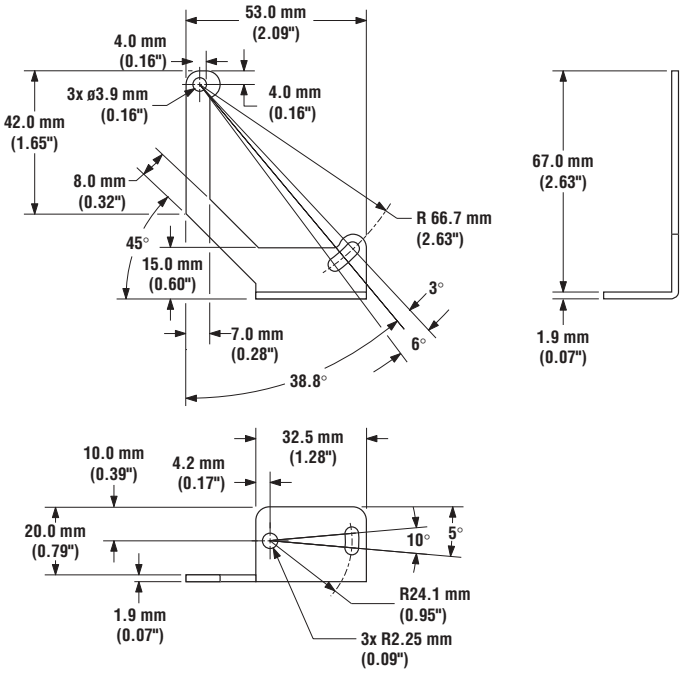


Quick-Disconnect (QD) Cables

Following is the selection of cables available for Q50 QD models. See the Accessories section for more cable information.

Style	Model	Length	Connector	Used with:
5-Pin Euro	**MQDEC2-506**	2 m (6.5')	Straight	All Q50 sensors with QD fitting
	MQDEC2-515	5 m (15')	Straight	
	MQDEC2-530	9 m (30')	Straight	
	MQDEC2-506RA	2 m (6.5')	Right-angle	
	MQDEC2-515RA	5 m (15')	Right-angle	
	MQDEC2-530RA	9 m (30')	Right-angle	

Mounting Brackets

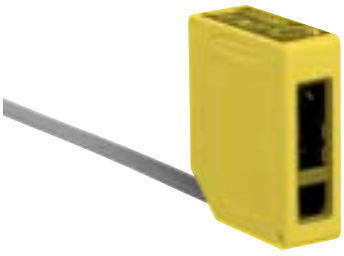
Model	Description	Dimensions
SMBQ50 	• Right-angle bracket • 14-ga., 304 Stainless Steel	

NOTES:

Q60 Adjustable Field Sensors

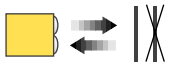
Q60 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

Q60 Adjustable Field Sensors

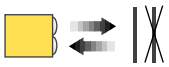


- Long-range adjustable-field background suppression sensor allows direct detection of objects within a defined sensing field, while ignoring objects located beyond the sensing field cutoff
- Two-turn, logarithmic adjustment of sensing field cutoff point from 0.2 to 2 m; allows easy setting of cutoff point at long range
- Rolling pointer indicates relative cutoff point setting
- Easy pushbutton or remote programming of light/dark operate and output timing; continuous status indicators verify all settings at a glance
- Output ON and/or OFF delays adjustable from 8 milliseconds to 16 seconds
- Available with integral cable or rotating euro-style quick-disconnect fitting
- Powerful infrared sensing beam
- Powered by 10 to 30V dc; bipolar (one NPN and one PNP) outputs
- Tough, ABS/polycarbonate blend housing is rated IEC IP67; NEMA 6

Q60 Sensing Mode Options

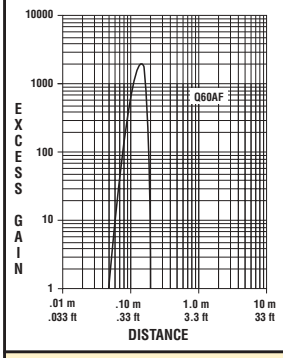
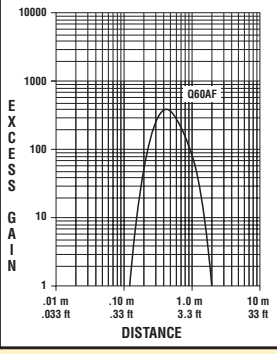


Adjustable-Field

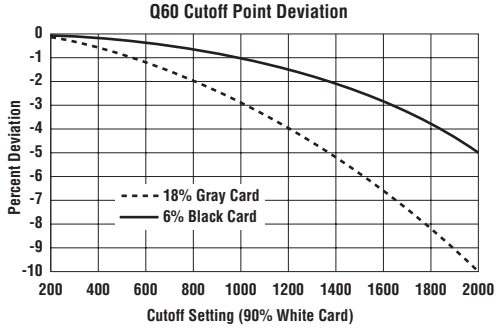


Infrared, 880 nm

Q60 Adjustable Field Mode

Models	Range	Cutoff Point	Cable	Supply Voltage	Output Type	Excess Gain at 200 mm Cutoff	Excess Gain at 2000 mm Cutoff
Q60BB6AF2000	50 mm to 125 mm (2 to 5") to Cutoff point	200 mm to 2000 mm (8 to 80")	5-wire 2 m (6.5')	10-30V dc	Bipolar NPN/PNP		
Q60BB6AF2000Q			5-pin Euro QD				

Cutoff Point Deviation



Interpretation of Performance Curves for Adjustable Field Models

The percentage of deviation indicates a change in the cutoff point for either 18% gray or 6% black targets, relative to the cutoff point set for a 90% reflective white test card.

As an example, the cutoff point decreases 10% for a 6% reflectance black target when the cutoff point is adjusted for 2000 mm (79") using a 90% reflectance white test card. In other words, the cutoff point for the black target is 1800 mm (71") for this setting.

For Q60 Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **QM60BBAF2000W/30**)

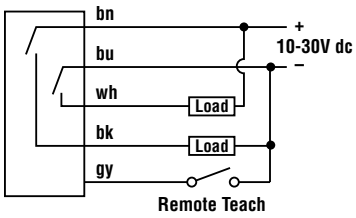
ii) A model with a QD connector requires an accessory mating cable. See page 272 and the Accessories section for more information.

Q60 Specifications

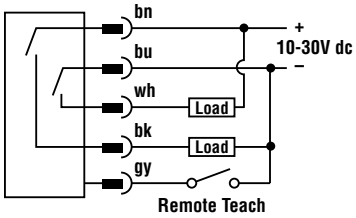
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 50 mA exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: one NPN (current sinking) and one PNP (current sourcing) open-collector transistor
Output Rating	150 mA maximum each output @ 25C **Off-state leakage current:** <5µA @ 30V dc **Output saturation NPN:** <200 mV @ 10 mA and <1V @150mA **Output saturation PNP:** <1V at 10 mA; <1.5V at 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs
Output Response Time	2 milliseconds NOTE: 150 millisecond delay on power-up; outputs are non-conducting during this time.
Repeatability	500 microseconds
Sensing Hysteresis	2000 mm cutoff - less than 3% of set cutoff distance 1600 mm cutoff - less than 2.25% of set cutoff distance 1200 mm cutoff - less than 1.30% of set cutoff distance 800 mm cutoff - less than 0.5% of set cutoff distance 400 mm cutoff - less than 0.25% of set cutoff distance
Adjustments	**2 momentary push buttons:** [ON Delay (+) an OFF Delay (-)] ON Delay select: 8 ms to 16 seconds OFF Delay select: 8 ms to 16 seconds LO/DO Push button lockout for security **Remote program wire:** ON Delay select: 8 ms to 16 seconds OFF Delay select: 8 ms to 16 seconds LO/DO Push button lockout for security Slotted, geared, 2-turn, cutoff range adjustment screw (mechanical stops on both ends of travel)
Indicators Note: outputs are active during on/off timing selection mode.	**Light Operate** (green) **Dark Operate** (green) **Output** (bicolor amber/green) **Run Mode** (amber): outputs conducting **Delay Timing Selection** (green): part of 5-segment light bar **Signal** (green)**:** Steady: sensor receiving signal Flashing: marginal signal indication (1.0 to 2.25 excess gain) **Lockout** (green): indicates buttons are locked out **On Delay** (green): Steady: indicates in run mode an On delay is active Flashing: in On delay selection mode **Off Delay** (green): Steady: indicates in run mode an Off delay is active Flashing: in Off delay selection mode **5 segment light bar** (LO, DO, signal, output and lockout) (green): indicators used to show relative delay time during OFF and ON delay selection modes
Construction	**Housing:** ABS polycarbonate blend **Lens:** acrylic **Cover:** Clear ABS
Environmental Rating	IEC IP67; NEMA 6
Connections	2 m (6.5') or 9 m (30') attached cable, or 5-pin Euro-style fitting. QD cables are ordered separately. See page 272 and Accessories section.
Operating Conditions	**Temperature:** -20° to +55°C (-7° to +131°F) **Maximum Relative Humidity:** 90% at 50°C (non-condensing)
Certifications	CE approval in process.

Q60 Hookup Diagrams

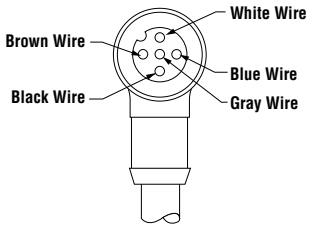
Cabled Models



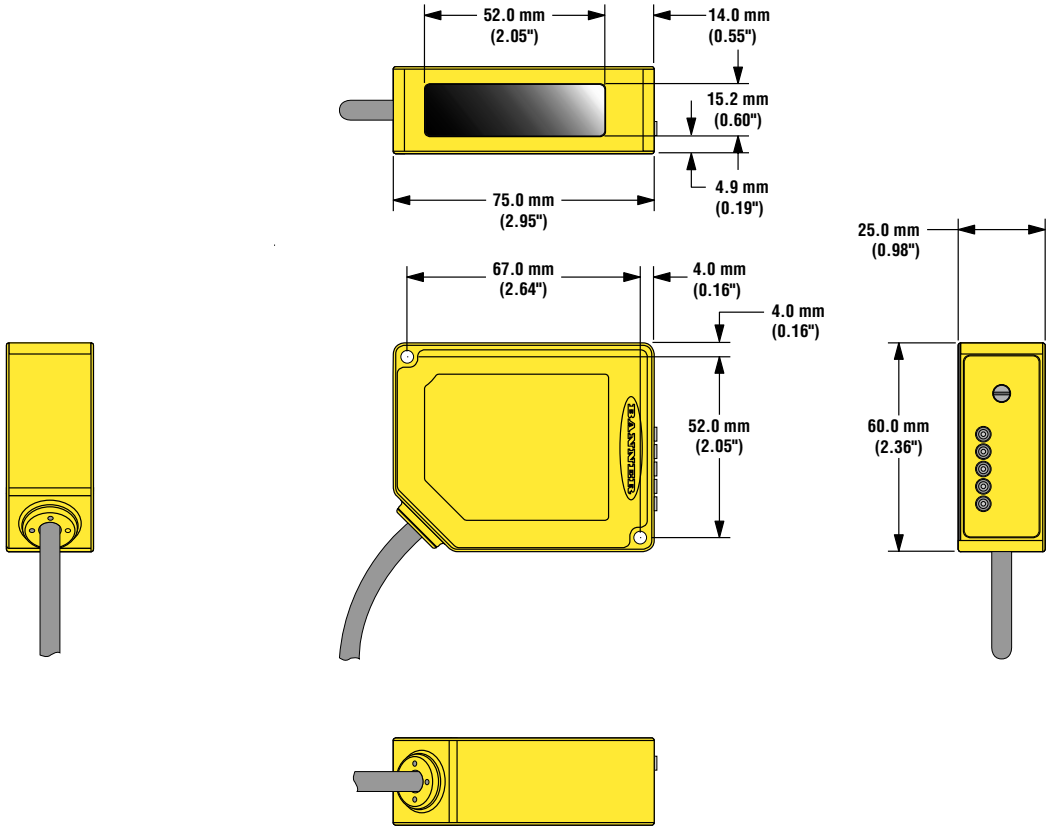
Quick-Disconnect Models



5-Pin Euro-Style Pin-out (Cable Connector Shown)



Q60 Adjustable Field Dimensions



Quick-Disconnect (QD) Option

Q60 sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable or with a 5-pin euro-style QD cable fitting. Q60 QD sensors are identified by the letter “Q” in their model number suffix. Information on mating cables for Q60 QD sensors can be found on page 272 and in the Accessories section. Cables are supplied in a standard length of 2 m (6.5').

Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All Q60 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	Q60BB6AF2000W/30

Quick-Disconnect (QD) Cables

Following is the selection of cables available for Q60 QD models. See the Accessories section for more cable information.

Style	Model	Length	Connector	Used with:
5-Pin Euro	**MQDC1-506**	2 m (6.5')	Straight	All Q60 sensors with QD fitting
	MQDC1-515	5 m (15')	Straight	
	MQDC1-530	9 m (30')	Straight	
	MQDC1-506RA	2 m (6.5')	Right-angle	
	MQDC1-515RA	5 m (15')	Right-angle	
	MQDC1-530RA	9 m (30')	Right-angle	

SM512 Sensors

CE (Except model SM502A))

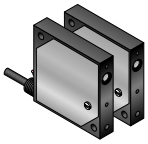
SM512 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

SM512 SENSORS

SM512 Diffuse and Convergent Modes Shown

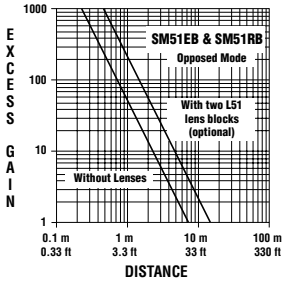
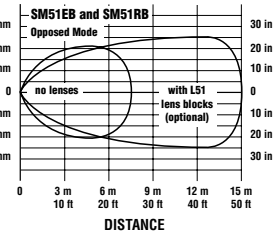
- 10 to 30V dc operation (most models - see Specifications)
- Complementary NPN (current sinking) outputs, each rated for up to 1/4 amp (most models)
- 2 m (6.5') cable length is standard; 9 m (30') is also available
- Rear-panel alignment indicator; side-panel sensitivity adjustment
- Special precise-focus convergent beam model SM512DBCV produces sensing spot measuring only 0.25 mm (0.01") in diameter at the focus
- Special short-range retroreflective model SM502A uses beam splitter optics to eliminate the close-range "blind spot" usually encountered with retro sensors

SM512 Sensing Mode Options



Infrared, 880 nm

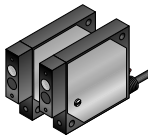
SM512 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SM51EB **SM51RB**	8 m (25')	2 m (6.5')	10-30V dc	Comple-mentary NPN		Effective Beam: 3.6 mm 

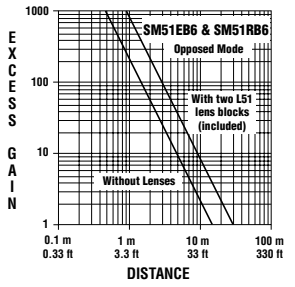
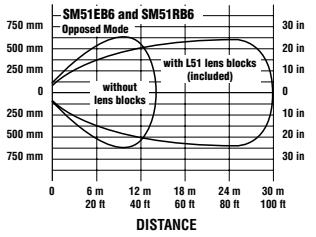
For SM512 Sensors:

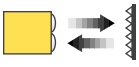
i) 9 m (30') cables are available by adding suffix "W/30" to the model number of any cabled sensor (e.g. - **SM51RB W/30**)

Infrared, 880 nm



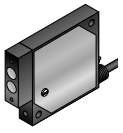
SM512 High Power Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SM51EB6 **SM51RB6**	30 m (100')	2 m (6.5')	10-30V dc	Light Operate NPN		Effective Beam: 3.6 mm 

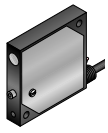


See Sensing Beam Information Below

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

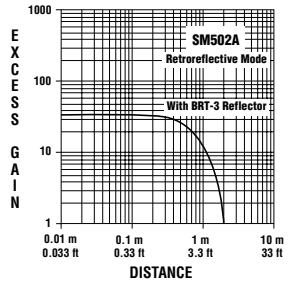
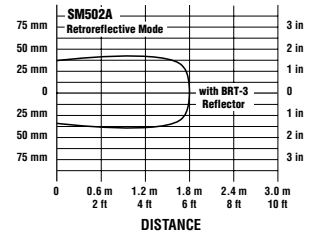
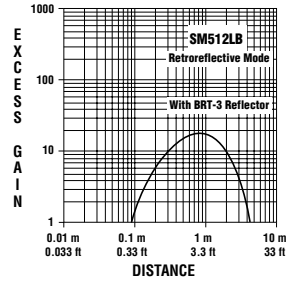
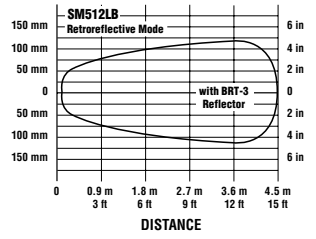


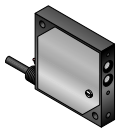
SM512LB

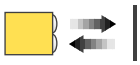


SM502A

SM512 Non-Polarized Retroreflective Mode

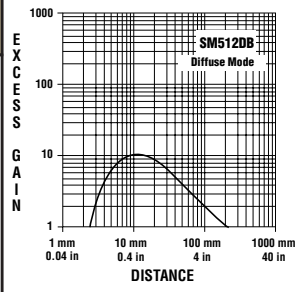
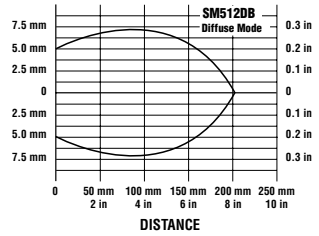
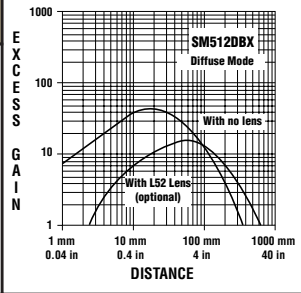
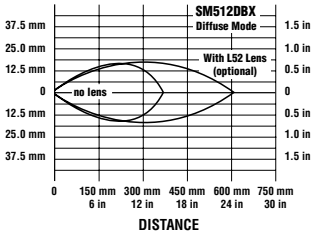
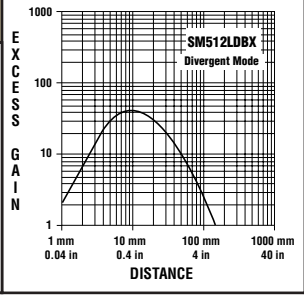
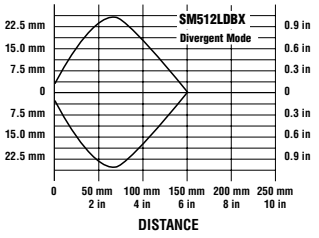
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Visible Red 650 nm						
SM502A	2 m (6')	2 m (6.5')	12-18V dc	Comple-mentary NPN		
Infrared 940 nm						
SM512LB	0.1 - 5 m (3" - 15')	2 m (6.5')	10-30V dc	Comple-mentary NPN		





See Sensing Beam Information Below

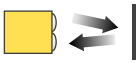
SM512 Diffuse Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Infrared 940 nm						
SM512DB	200 mm (8")	2 m (6.5')	10-30V dc	Complementary NPN		
Infrared 880 nm						
SM512DBX	380 mm (15")	2 m (6.5')	10-30V dc	Complementary NPN		
Divergent Diffuse (Infrared 880 nm)*						
SM512LBDX	150 mm (6")	2 m (6.5')	10-30V dc	Complementary NPN		

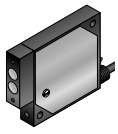
*Note: Model SM512LBDX is recommended for sensing clear materials.

For SM512 Sensors:

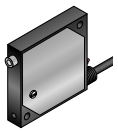
i) 9 m (30') cables are available by adding suffix "W/30" to the model number of any cabled sensor (e.g. - **SM512LBDX W/30**)



See Sensing Beam Information Below

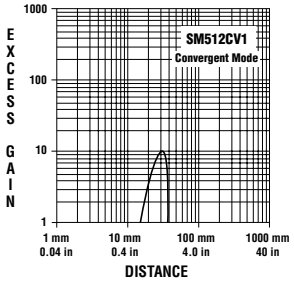
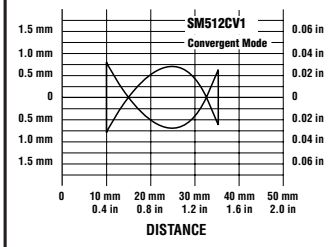
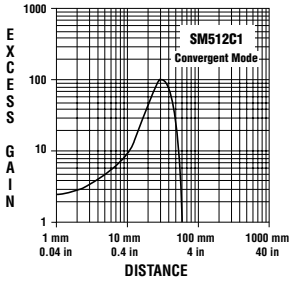
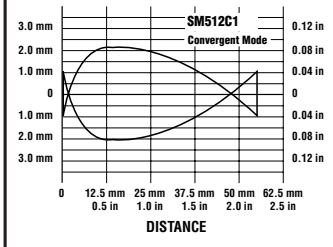
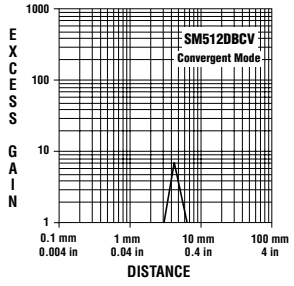
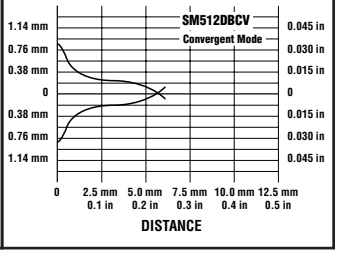


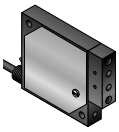
SM512CV1 and C1



SM512DBCV

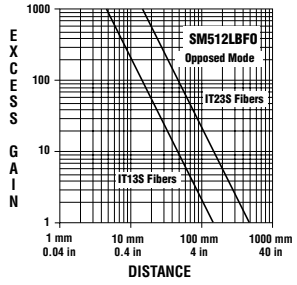
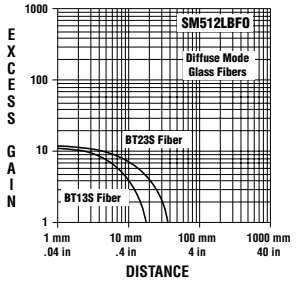
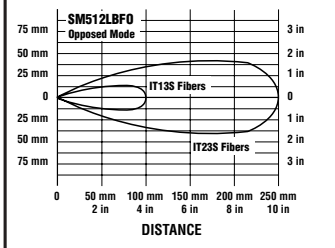
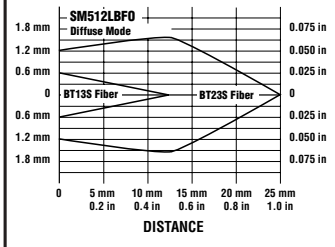
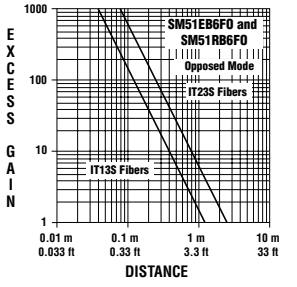
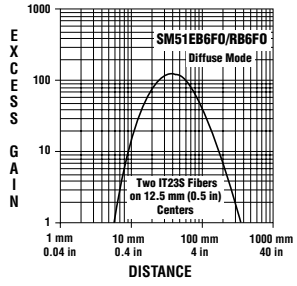
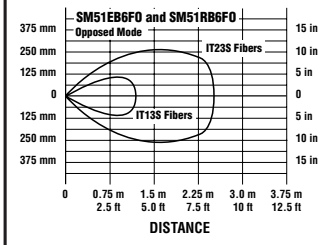
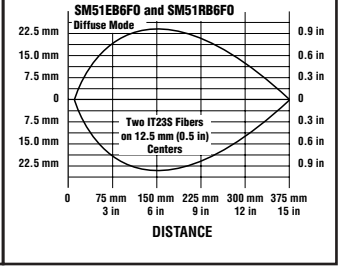
SM512 Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Visible Red 650 nm						
SM512CV1	32 mm (1.25") Spot Size at Focus: 1.0 mm (0.04")	2 m (6.5')	10-30V dc	Complementary NPN		
Infrared 940 nm						
SM512C1	32 mm (1.25") Spot Size at Focus: 3.18 mm (0.125")	2 m (6.5')	10-30V dc	Complementary NPN		
Precise Convergent (Visible Red 700 nm)						
SM512DBCV	4.32 mm (0.170") Spot Size at Focus: 0.25 mm (0.01")	2 m (6.5')	10-30V dc	Complementary NPN		



See Sensing Beam Information Below

SM512 Glass Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Infrared 940 nm						
SM512LBFO	Range varies by sensing mode and fiber optics used	2 m (6.5')	10-30V dc	Complementary NPN	 	 
Infrared 940 nm						
SM51EB6FO **SM51RB6FO**	Range varies by sensing mode and fiber optics used	2 m (6.5')	10-30V dc	Complementary NPN	 	 

For SM512 Sensors:

i) 9 m (30') cables are available by adding suffix "W/30" to the model number of any cabled sensor (e.g. - **SM51EB6FO W/30**)

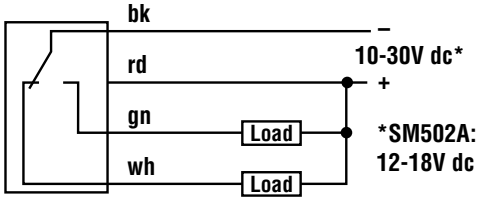
SM512 Specifications

Supply Voltage and Current	10 to 30V dc (except model SM502A which operates from 12-18V dc) with 10% maximum ripple at less than 40 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Complementary open-collector NPN transistors (one normally open and one normally closed) Exceptions: SM51RB6 has only one output
Output Rating	Each output transistor is capable of sinking up to 250 mA continuously **Off-state leakage current** less than 100 microamps **On-state saturation voltage** less than 2 volts at full load and <1 volt at signal levels
Output Protection Circuitry	Protected against continuous overload or short circuit of outputs (except SM502A which has momentary short circuit protection)
Output Response Time	1 millisecond both “ON” and “OFF” for most models (500 Hz maximum). Models SM512DBX, SM512LBDX and SM51RB6 have 10-millisecond response
Repeatability	**Opposed:** 0.1 millisecond; **Retro, Diffuse, Convergent, Glass Fiber Optic:** 0.3 milliseconds; **SM502A and SM512DBCV:** 0.03 millisecond and **RB6(FO):** 1 millisecond. Response time and repeatability are independent of signal strength.
Adjustments	Single-turn adjustment, accessible by removing the nylon screw on the side of the sensor
Indicators	Red LED indicator at rear of sensor (above cable exit) lights when the sensor is receiving a “light” signal
Construction	Die-cast metal housing, stainless steel legend plate. Exceptions: sensor models SM512C1 and SM512CV1 have Delrin® plastic housing, totally encapsulated and lens assemblies fully gasketed
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12, and 13; IEC IP66
Connections	PVC-jacketed 2- or 4-conductor 2 m (6.5') or 9 m (30') cables
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Outputs will not directly interface TTL logic, due to the reverse-polarity protection diode. Contact the factory for TTL interfacing instructions.
Certifications	CE Except model SM502A

Delrin® is a registered trademark of Dupont

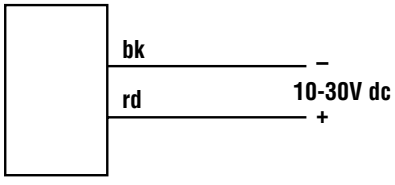
SM512 Hookup Diagrams

SM512 Sensors

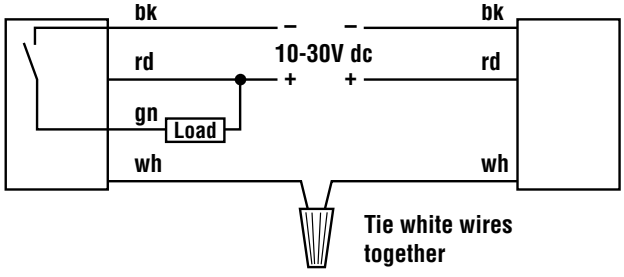


SM51 Emitters

(Except models with suffix “B6”)



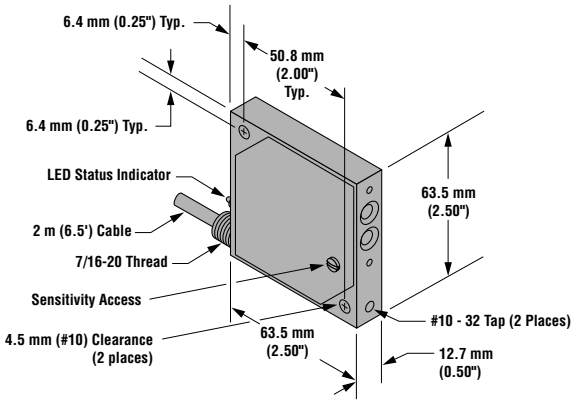
SM51RB6(FO)



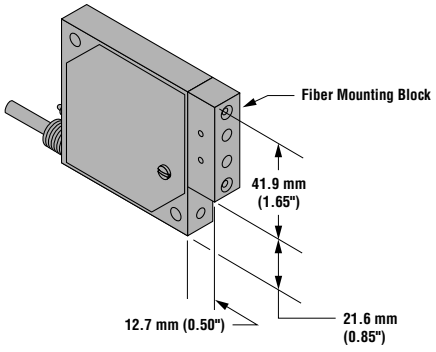
SM51EB6(FO)

SM512 Dimensions

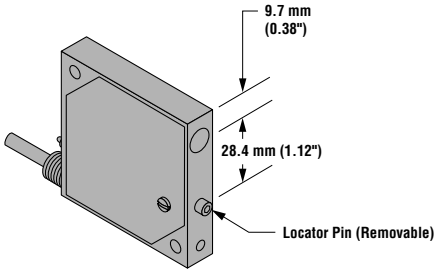
SM51E/RB and SM512DB, DBX and LBDX Sensors Opposed & Diffuse Sensing Modes



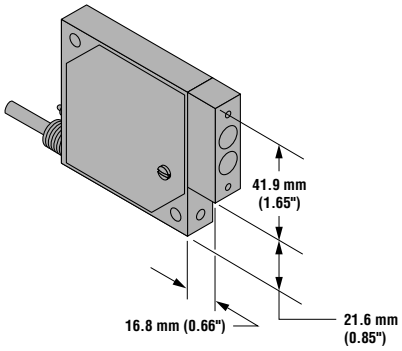
SM512LBFO and SM51E/RB6FO Sensors Glass Fiber Optic Mode



SM502A Sensor - Retro Mode

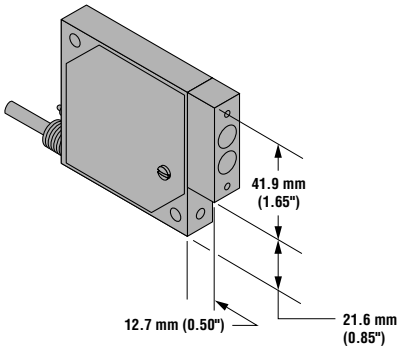


SM512LB and SM51E/RB6 Sensors Retro & High Power Opposed Mode

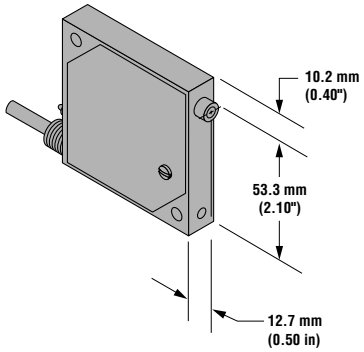


SM512 Convergent Mode

SM512CV1 and C1



SM512DBCV



Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	SM512 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	SM512DB W/30
MHS	Modified for High Speed	SM512 sensors with 1 millisecond output response (SM51EB. SM51RB, SM502A, SM512LB, SM512DB, SM512CV1, SM512C1, SM512DBCV & SM512LFO) may be modified for 0.3 millisecond (300 µs) response. NOTE: Faster response comes at the expense of lower excess gain.	SM512DBMHS

Extension Cables (without connectors)

The following cable is available for extending the length of existing sensor cable. This is a 30 m (100') length of SM512 cable. This cable may be spliced to existing cable. Connectors, if used, must be customer-supplied.

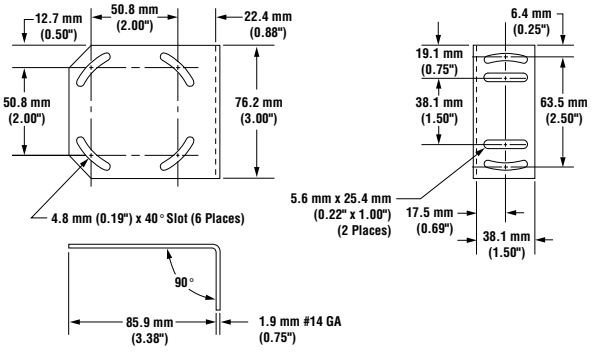
Model	Type	Used with:
EC512-100	4-conductor, shielded	All SM512 Series models

Right-Angle Reflectors

The SM512 right-angle reflector is useful for tight sensing locations. NOTE: Range is reduced by about 50% when used

Model	Description	
RAR500	Right-angle beam deflector used to reflect the light beam at 90 degrees to the sensor package. Recommended for opposed mode sensing only.	

Mounting Brackets

Model	Description	Dimensions
SMB500 **SMB500SS** 	• SMB500: Universal steel mounting bracket - bright zinc plated • SMB500SS: Universal stainless steel mounting bracket	

Replacement Lens Assemblies

Model	Description	
BZ500	Plastic lens cover for any SM512 Series sensors that does not use a lens block	
L51	Replacement lens block for extending the range of any SM512 Series emitter or receiver	
L52	Replacement lens block for SM512LB. Extends range of SM512DB and SM512DBX by about 50% and reduces beam diameter	
L52AB	Aperture block used with any SM512 Series emitter or receiver to create very narrow effective beams. Each L52AB comes with a 1 mm (0.04") in diameter aperture and a 0.76 x 3.2 mm (0.03 x 0.125") rectangular aperture	
FOF-500	Replacement fiberoptic interface block for SM512LBFO, SM51EB6FO or SM51RB6FO. Creates fiberoptic sensor from SM512DB, SM512DBX or emitter/receiver pairs	

Fittings and Conduits

Model	Description	
CF7-16	Aluminum compression fitting for the cable entrance at the rear of the SM512 Series sensors (except SM512C1 or SM512CV1). May be used with either plastic or flexible steel conduit (PVC-6 or AC-6).	
AC-6 **AC-30**	2 and 9 meter (6 and 30') lengths of flexible steel conduit used with any SM512 Series sensors and the CF7-16 fitting to provide protection to the sensor Size: I.D. = 7.9 mm (0.31"); O.D. = 11.2 mm (0.44")	
PVC-6 **PVC-30**	2 and 9 meter (6 and 30') lengths of flexible steel conduit used with any SM512 Series sensors and the CF7-16 fitting in food applications where flexible steel conduit is not allowed Size: I.D. =6.4 mm (0.25"); O.D. = 9.7 mm (0.38")	

SM30 Sensors

SM30 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

SM30 BARREL SENSORS

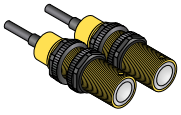
for Especially Demanding Applications

† U.S. Patent #4982107

- Very high excess gain; 200 m (700') sensing range
- Choice of thermoplastic polyester or stainless steel housing
- Models for 10 to 30V dc or 24 to 240V ac operation
- DC receivers feature Banner's unique† Bi-Modal™ output circuitry which offers NPN (sinking) or PNP (sourcing) output and light operate or dark operate in the same sensor (see hookup information)
- AC receivers offer simple 2-wire hookup
- Choose 2 m (6.5') integral cable or quick-disconnect (QD) fitting for optional mini-style QD cables; 9 m (30') integral cable is also available
- Modulation frequency "A" is standard; frequencies "B" and "C" are also available to minimize optical crosstalk potential between adjacent sensor pairs

SM30 Sensing Mode Options

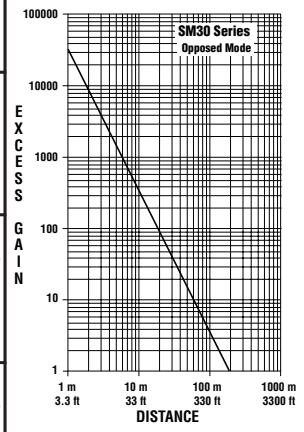
Opposed

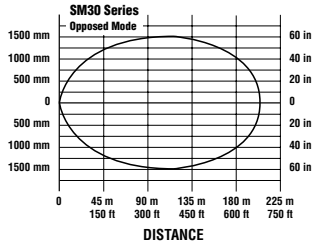


Infrared, 880 nm

SM30 Opposed Mode Emitter (E) and Receiver (R) - Modulation Frequency A

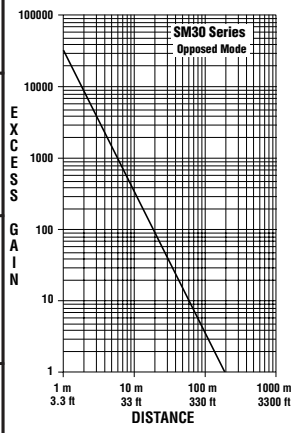
Models	Housing	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMA30PEL **SMA30PELQD**	Plastic	2 m (6.5') 3-Pin Mini QD	10-30V dc or 12 to 240Vac	–	Range: 200 m (700')	Effective Beam: 19 mm
SMA30SEL **SMA30SELQD**	Stainless Steel	2 m (6.5') 3-Pin Mini QD				
SM30PRL **SM30PRLQD**	Plastic	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bi-Modal™ NPN/PNP LO and DO		
SM30SRL **SM30SRLQD**	Stainless Steel	2 m (6.5') 4-Pin Mini QD				
SM2A30PRL **SM2A30PRLQD**	Plastic	2 m (6.5') 3-Pin Mini QD	12 to 240V ac	SPST Solid-state LO		
SM2A30SRL **SM2A30SRLQD**	Stainless Steel	2 m (6.5') 3-Pin Mini QD				
SM2A30PRLNC **SM2A30PRLNCQD**	Plastic	2 m (6.5') 3-Pin Mini QD		SPST Solid-state DO		
SM2A30SRLNC **SM2A30SRLNCQD**	Stainless Steel	2 m (6.5') 3-Pin Mini QD				

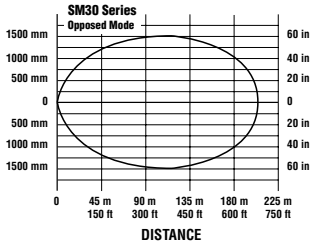




SM30 Opposed Mode Emitter (E) and Receiver (R) - Modulation Frequency B

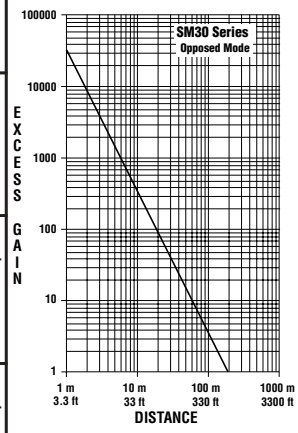
Models	Housing	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMA30PELB **SMA30PELQDB**	Plastic	2 m (6.5') 3-Pin Mini QD	10-30V dc or 12 to 240Vac	–	Range: 200 m (700')	Effective Beam: 19 mm
SMA30SELB **SMA30SELQDB**	Stainless Steel	2 m (6.5') 3-Pin Mini QD				
SM30PRLB **SM30PRLQDB**	Plastic	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bi-Modal™ NPN/PNP LO and DO		
SM30SRLB **SM30SRLQDB**	Stainless Steel	2 m (6.5') 4-Pin Mini QD				
SM2A30PRLB **SM2A30PRLQDB**	Plastic	2 m (6.5') 3-Pin Mini QD	12 to 240V ac	SPST Solid-state LO		
SM2A30SRLB **SM2A30SRLQDB**	Stainless Steel	2 m (6.5') 3-Pin Mini QD				
SM2A30PRLNCB **SM2A30PRLNCQDB**	Plastic	2 m (6.5') 3-Pin Mini QD		SPST Solid-state DO		
SM2A30SRLNCB **SM2A30SRLNCQDB**	Stainless Steel	2 m (6.5') 3-Pin Mini QD				

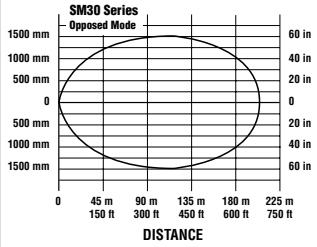




SM30 Opposed Mode Emitter (E) and Receiver (R) - Modulation Frequency C

Models	Housing	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMA30PELC **SMA30PELQDC**	Plastic	2 m (6.5') 3-Pin Mini QD	10-30V dc or 12 to 240Vac	–	Range: 200 m (700')	Effective Beam: 19 mm
SMA30SELC **SMA30SELQDC**	Plastic	2 m (6.5') 3-Pin Mini QD				
SM30PRLC **SM30PRLQDC**	Stainless Steel	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bi-Modal™ NPN/PNP LO and DO		
SM30SRLC **SM30SRLQDC**	Stainless Steel	2 m (6.5') 4-Pin Mini QD				
SM2A30PRLC **SM2A30PRLQDC**	Plastic	2 m (6.5') 3-Pin Mini QD	12 to 240V ac	SPST Solid-state LO		
SM2A30SRLC **SM2A30SRLQDC**	Plastic	2 m (6.5') 3-Pin Mini QD				
SM2A30PRLNCC **SM2A30PRLNCQDC**	Stainless Steel	2 m (6.5') 3-Pin Mini QD		SPST Solid-state DO		
SM2A30SRLNCC **SM2A30SRLNCQDC**	Stainless Steel	2 m (6.5') 3-Pin Mini QD				





For SM30 Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SM2A30SRLC W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 295 and the Accessories section for more information.

iii) The SM30 sensor comes in a thermoplastic polyester housing identified by the letter "P" in the model number (e.g. - SMA30**P**ELC) or in a stainless steel housing identified by the letter "S" in the model number (e.g. - SMA30**S**ELC).

SM30 Specifications

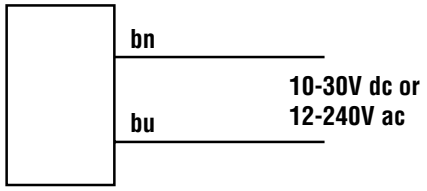
Supply Voltage and Current	*Emitters:* 12 to 240V ac (50/60 Hz) or 10-30V dc at 20 mA, 10 % maximum ripple *DC Receivers:* 10 to 30V dc at 10 mA maximum (exclusive of load); 10% maximum ripple *AC Receivers:* 24 to 240V ac (50/60 Hz)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	*DC Receivers:* Bi-Modal™ output (PNP sourcing or NPN sinking). Selection of sourcing or sinking configuration depends upon receiver's power supply hookup polarity. *AC Receivers:* Solid-state switch
Output Rating	*DC Receivers:* 250 mA continuous **Output saturation voltage** (PNP & NPN configuration) less than 1 volt at 10 mA and less than 2 volts at 250 mA **Off-state leakage** current less than 10 microamps *AC Receivers:* Maximum steady-state load capability is 500 mA **Inrush capability** 10 amps for 1 second (non-repeating) **Off-state leakage** current less than 1.7 mA rms **On-state voltage** drop less than 3.5 volts rms across a 500 mA load; less than 5 volts rms across a 15 mA load
Output Protection Circuitry	Outputs of dc receivers are short circuit protected
Output Response Time	10 milliseconds on/off
Repeatability	"A" frequency units: 1 ms "B" frequency units: 1.5 ms "C" frequency units: 2.3 ms
Indicators	Internal red LED lights whenever the dc receiver sees its modulated light source, or whenever the ac receiver's output is conducting. Emitters have red "power on" indicator LED. All indicators are visible through the lens or from side of the sensor.
Construction	Plastic units: 30 mm diameter tubular threaded thermoplastic polyester housing, fully epoxy-encapsulated, positive sealing at both ends, quad-ring sealed acrylic lens. Two thermoplastic polyester jam nuts provided. Stainless Steel units: 30 mm diameter tubular threaded stainless steel housing, fully epoxy-encapsulated, positive sealing at both ends, quad-ring sealed acrylic lens. Two stainless steel jam nuts provided.
Environmental Rating	Exceeds NEMA 6P and IEC IP67 standards
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables or mini-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 295 and Accessories section.
Operating Temperature	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	

SM30 Series Hookup Diagrams

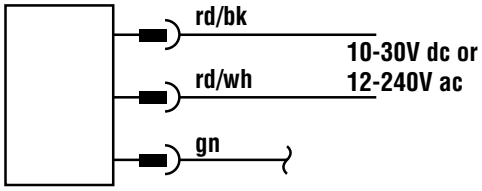
EMITTERS

NOTE: SM30 emitters are not polarity-sensitive when powered by dc voltage.

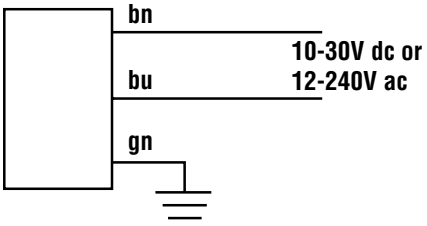
Cabled Emitters with Plastic Housings



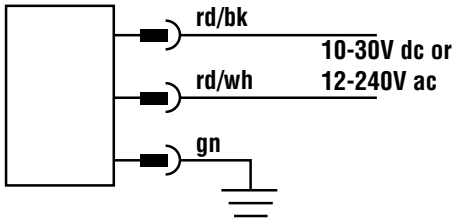
QD Emitters with Plastic Housings 3-Pin Mini-Style (Requires SM30CC Cable)



Cabled Emitters with Stainless Steel Housings



QD Emitters with Stainless Steel Housings 3-Pin Mini-Style (Requires SM30CC Cable)



NOTE: The green wire must be connected to earth ground whenever a model with a stainless steel housing is powered by ac voltage.

Quick-Disconnect (QD) Option

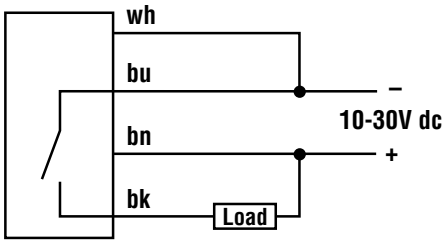
SM30 sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a mini-style QD cable fitting.

SM30 QD sensors are identified by the letters “QD” in their model number suffix. Mating cables for QD SM30 ac receivers and all emitters are model SM30CC-306 and SM30CC-312. Cables for QD SM30 dc receivers are MBCC-406, MBCC-412 and MBCC-430. For more information on QD cables, see page 295 and the Accessories section.

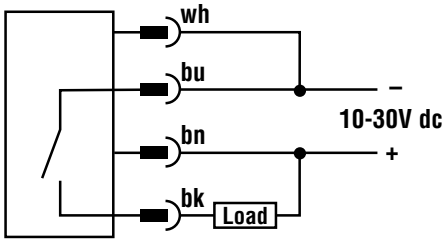
SM30 Series Hookup Diagrams

DC RECEIVERS

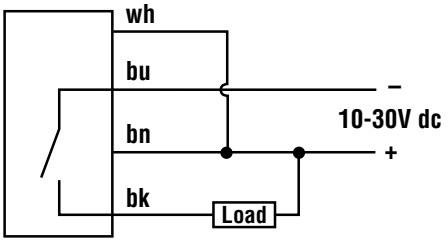
Cabled Current Sinking, Dark Operate



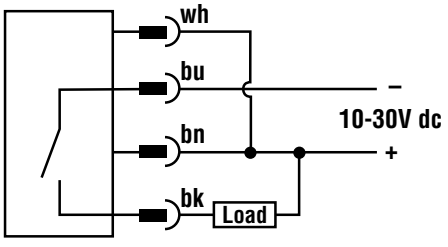
QD Current Sinking, Dark Operate (4-Pin Mini-Style)



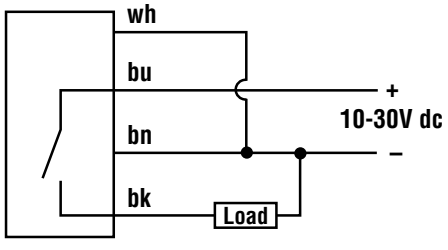
Cabled Current Sinking, Light Operate



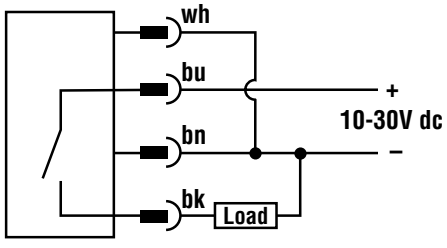
QD Current Sinking, Light Operate (4-Pin Mini-Style)



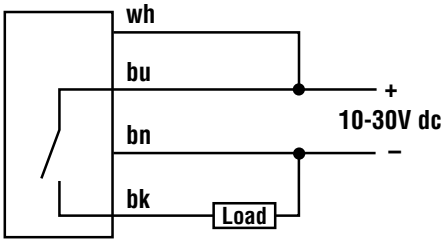
Cabled Current Sourcing, Dark Operate



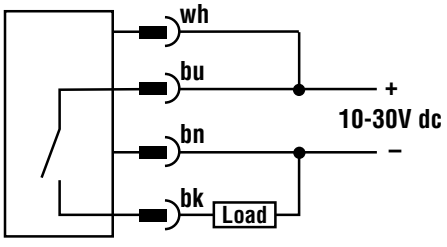
QD Current Sourcing, Dark Operate (4-Pin Mini-Style)



Cabled Current Sourcing, Light Operate



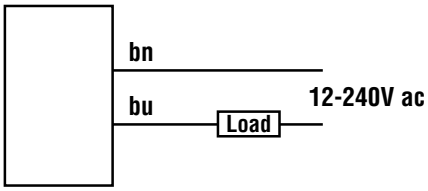
QD Current Sourcing, Light Operate (4-Pin Mini-Style)



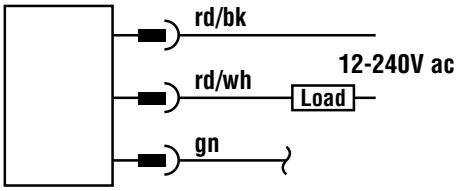
SM30 Series Hookup Diagrams

AC RECEIVERS

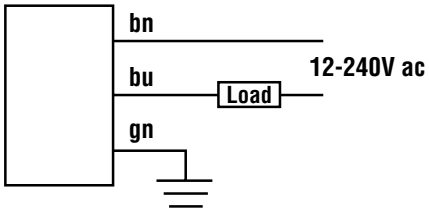
Cabled AC Receivers with Plastic Housings



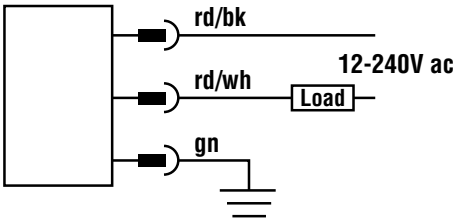
QD AC Receivers with Plastic Housings (3-Pin Mini-Style) (Requires SM30CC Cable)



Cabled AC Receivers with Stainless Steel Housings

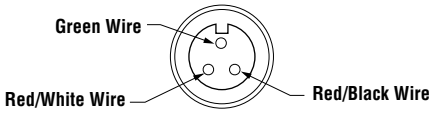


QD AC Receivers with Stainless Steel Housings (3-Pin Mini-Style) (Requires SM30CC Cable)

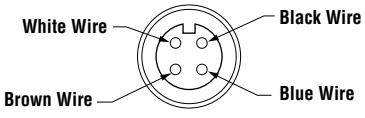


NOTE: The green wire must be connected to earth ground whenever a model with a stainless steel housing is powered by ac voltage.

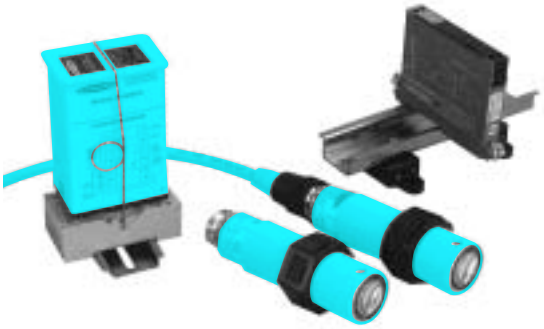
3-Pin Mini-Style Pin-out (Cable Connector Shown)



4-Pin Mini-Style Pin-out (Cable Connector Shown)



SMI30 Intrinsically Safe DC Sensors

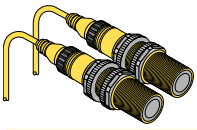


SMI30 Series sensors, shown with Intrinsic Safety Kit

- Extremely rugged and powerful opposed mode instrinsically safe barrel sensors designed for the most demanding hazardous area sensing applications
- Certified as intrinsically safe for use in all hazardous atmospheres as defined by Article 500 of the National Electrical Code, when used with approved “positive input” intrinsic safety barriers
- Also certified by Factory Mutual and CSA as non-incendive devices when used in Division 2 locations (except Groups E and F) without intrinsic safety barriers
- Select models with either 10 millisecond or 1 millisecond response
- 10 millisecond sensor pairs have 140 m (460') range; 1 millisecond pairs have 60 m (200') range
- Use each sensor pair with model CI3RC2 current trip point amplifier and dual-channel intrinsic safety barrier for a complete intrinsically safe sensing system; see page 292 for kit information
- Sensor connection is via 3-pin mini-style quick-disconnect cable (ordered separately, see page 295)
- Modulation frequency “A” is standard; frequencies “B” and “C” are also available to minimize optical crosstalk potential between adjacent sensor pairs

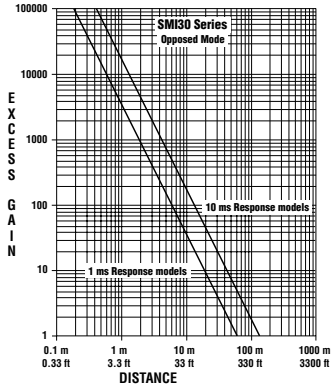
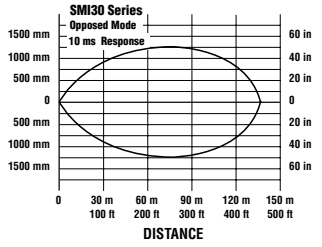
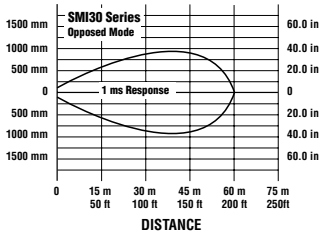
SMI30 Sensing Mode Options

Opposed

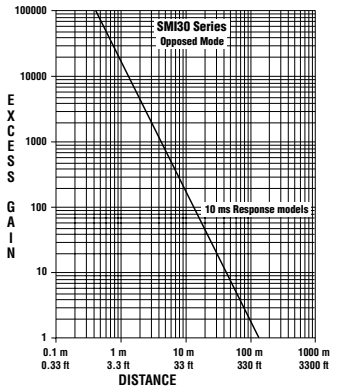
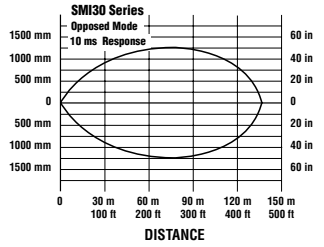


Infrared, 880 nm

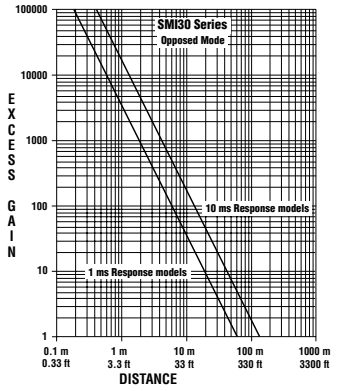
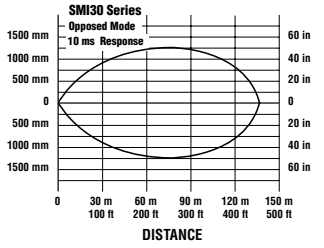
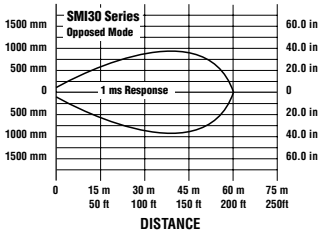
SMI30 Opposed Mode Emitter (E) and Receiver (R) - Modulation Frequency A

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
		10 ms response				Effective Beam: 19 mm
SMI306EQ	140 m (460')	3-Pin Mini QD	10-30V dc	None		
SMI30AN6RQ				Light Operate NPN		
SMI30RN6RQ				Dark Operate NPN		
		1 ms response				
SMI306EYQ	60 m (200')	3-Pin Mini QD	10-30V dc	None		
SMI30AN6RYQ				Light Operate NPN		
SMI30RN6RYQ				Dark Operate NPN		

SMI30 Opposed Mode Emitter (E) and Receiver (R) - Modulation Frequency B

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
		10 ms response				Effective Beam: 19 mm
SMI306EBQ	140 m (460')	3-Pin Mini QD	10-30V dc	None		
SMI30AN6RBQ				Light Operate NPN		
SMI30RN6RBQ				Dark Operate NPN		

SMI30 Opposed Mode Emitter (E) and Receiver (R) - Modulation Frequency C

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
		10 ms response				Effective Beam: 19 mm
SMI306ECQ	140 m (460')	3-Pin Mini QD	10-30V dc	None		
SMI30AN6RCQ				Light Operate NPN		
SMI30RN6RCQ				Dark Operate NPN		
		1 ms response				
SMI306EYCQ	60 m (200')	3-Pin Mini QD	10-30V dc	None		
SMI30AN6RYCQ				Light Operate NPN		
SMI30RN6RYCQ				Dark Operate NPN		

For SMI30 Sensors:

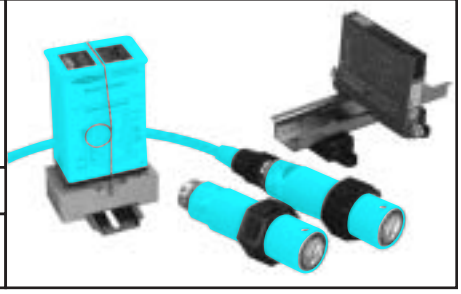
i) A model with a QD connector requires an accessory SMICC-3xx mating cable. See pages 295 and the Accessories section for more information.

SMI30 Specifications

Supply Voltage and Current	*Emitters:* 10 to 30V dc at 25 mA *Receivers:* 10 to 30V dc at 15 mA max. Division 1 use, with barriers, requires minimum system supply voltage of 10V. See hookup information, on page 293.
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	*Receivers:* Current sinking NPN open-collector transistor
Output Rating	Three-wire hookup sinks 15mA maximum continuous, 10-30V dc. Two-wire hookup sinks ≤10 mA
Output Protection Circuitry	Outputs are short circuit protected
Output Response Time	10 milliseconds or 1 millisecond on/off, depending on models; independent of signal strength
Repeatability	"A" frequency units: 10 millisecond receiver is 1 ms and 1 millisecond receiver is 360 µs "B" frequency units: 1.6 ms "C" frequency units: 10 millisecond receiver is 2.3 ms and 1 millisecond receiver is 210 µs Repeatability is independent of signal strength
Indicators	Internal red LED lights whenever the receiver sees the emitter's modulated light source. Emitters have red "power on" indicator LED. All indicators are visible through the lens or from side of the sensor.
Construction	30 mm diameter tubular threaded thermoplastic polyester housing, fully epoxy-encapsulated, positive sealing at both ends, quad-ring sealed acrylic lens. Two thermoplastic polyester jam nuts provided.
Environmental Rating	Exceeds NEMA 6P and IEC IP67 standards
Connections	3-wire mini-style quick-disconnect (QD) fitting. Use cable models SMICC-3xx (page 295). Cable electric properties: 40 pf/ft; 20 µH/ft. Order cable separately from sensor.
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE, CSA Exia NRTL/C, KEMA, FM APPROVED

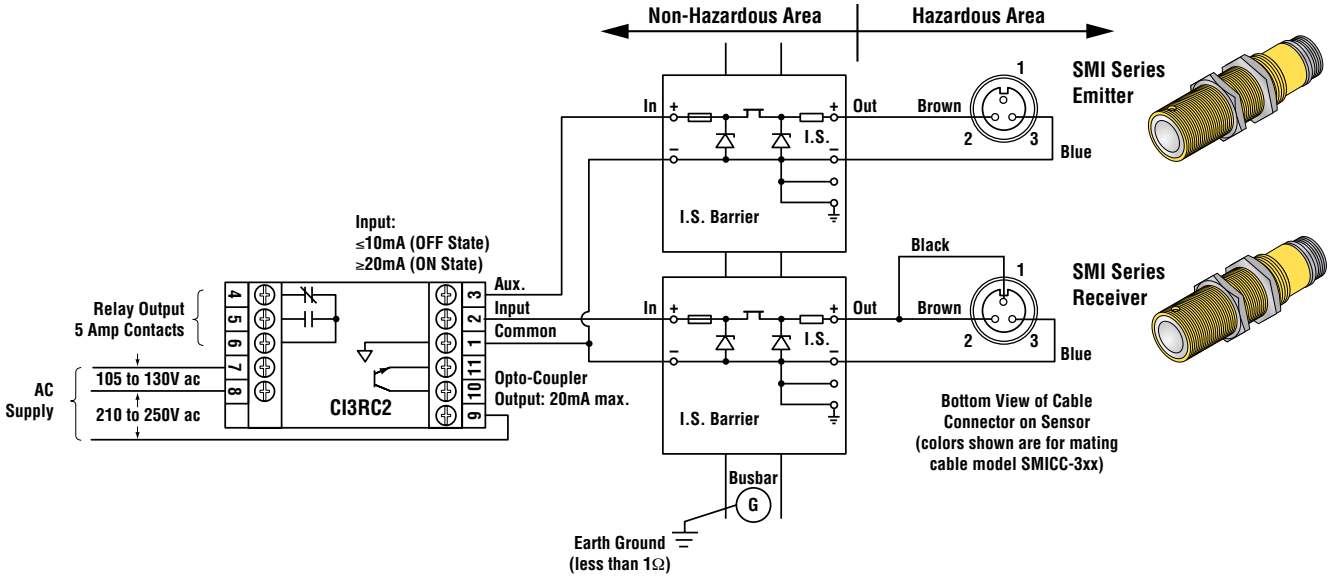
Intrinsic Safety Kits for Use with SMI30 Intrinsically Safe Sensors

Model	Description
CI2BK-1	Intrinsic safety kit includes a CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount and one single-channel instrinsically safe barrier
CI2BK-2	Intrinsic safety kit includes a CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount and one dual-channel instrinsically safe barrier
CI3RC2	Current trip point amplifier
CIB-1 **CI2B-1**	Single channel intrinsic safety barrier Dual channel intrinsic safety barrier

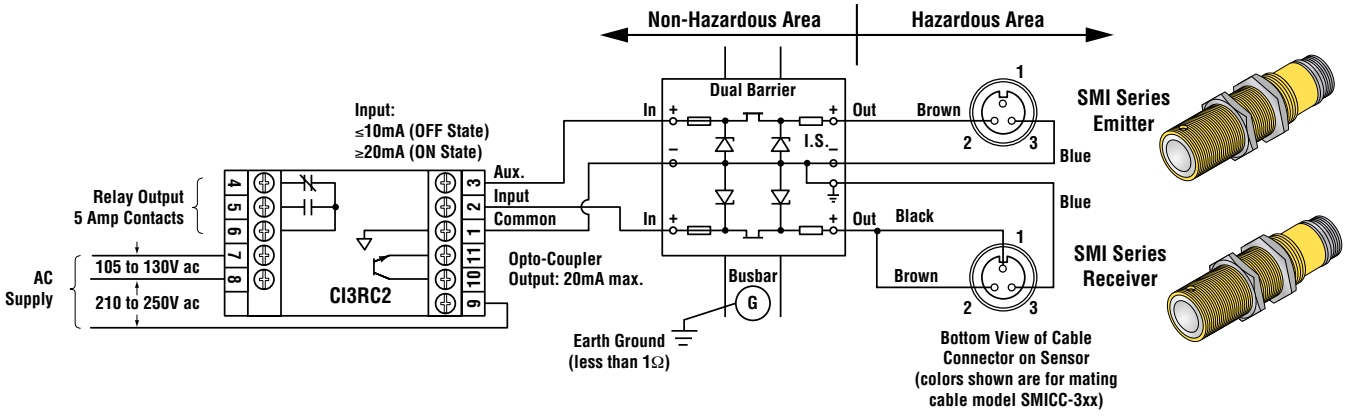


SMI30 DC Hookup Diagrams

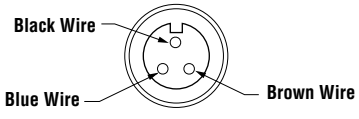
SMI30 Hookup Using Two Single-Channel Barriers



SMI30 Hookup Using One Dual-Channel Barrier



3-Pin Mini-Style Pin-out (Cable Connector Shown)

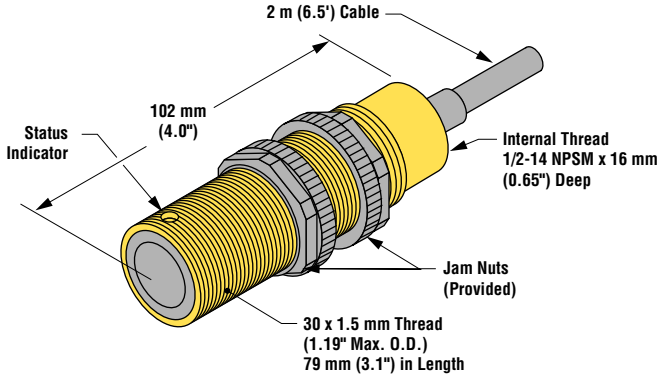


Quick-Disconnect (QD) Option

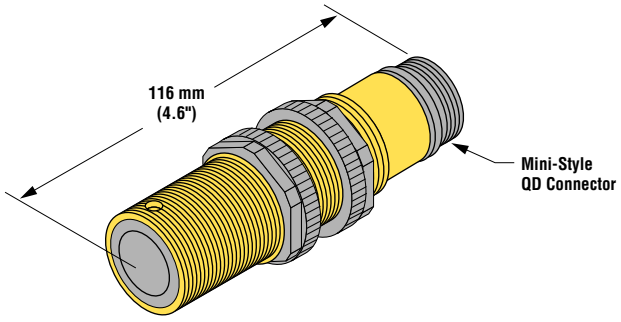
SMI30 sensors are sold with a mini-style QD cable fitting. Cables for SMI30 sensors are models SMICC-306 (2 m), SMICC-312 (4 m) and SMICC-330 (9m). For more information on QD cables, see page 295 and the Accessories section.

SM30 Dimensions

SM30 Sensor with Cable



SM30 or SMI30 Sensor with Quick-Disconnect



Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	SM30 Series sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	SM30PRL W/30

Quick-Disconnect (QD) Cables

Following is the selection of cables available for SM30 QD models. See the Accessories section at back of catalog for more cable information.

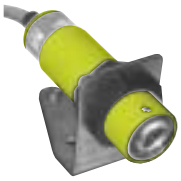
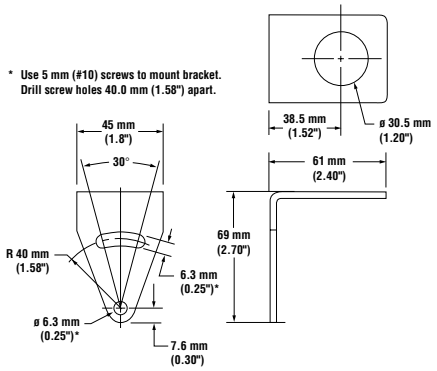
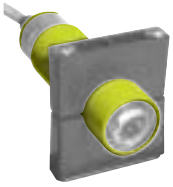
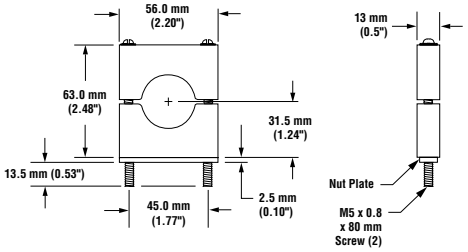
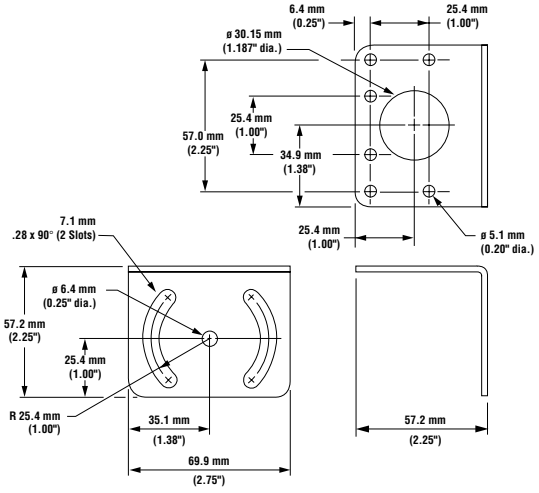
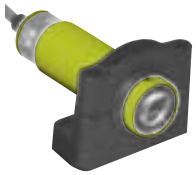
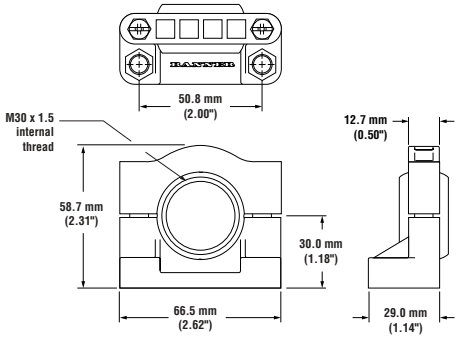
Style	Model	Length	Connector	Used with:
3-Pin Mini	**SM30CC-306** **SM30CC-312**	2 m (6.5') 4 m (12')	Straight	SM30 Series ac receivers and all emitters
	SMICC-306 **SMICC-312** **SMICC-330**	2 m (6.5') 4 m (12') 9 m (30')		SMI30 Intrinsically Safe dc sensors
4-Pin Mini	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 ms (30')	Straight	SM30 Series dc receivers

Aperture Kit

SM30 sensors may be fitted with apertures which narrow or shape the effective beam of the sensor to more closely match the size or profile of the object to be sensed. A common example is the use of “line” or “slit” type aperture when wire or thread is be sensed.

Model	Description		
APG30S	Kit includes: a thread-on stainless steel housing, a flat glass lens, two quad-ring seals, and 3 round and 3 slotted aperture disks		

Mounting Brackets

Model	Description	Dimensions
SMB30A 	• 12-gauge, stainless steel, right angle mounting bracket with a curved mounting slot for versatility and orientation • Clearance for M6 (1/4") hardware	
SMB30C 	• 30 mm split clamp bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting hardware	
SMB30MM 	• 30 mm, 12-gauge, stainless steel bracket with curved mounting slots for versatility and orientation • Clearance for M6 (1/4") hardware	
SMB30SC 	• 30 mm swivel bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting and swivel locking hardware	

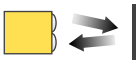
R55 Sensors

R55 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

R55 *Expert*™ Color Mark Sensors

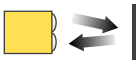
Color Registration Mark Sensor with Solid-State Light Source

R55 *Expert* Sensing Mode Options



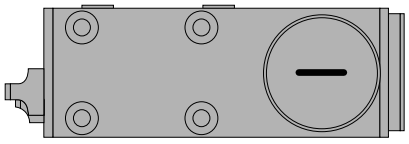
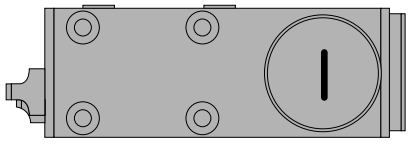
Convergent

- Outstanding color contrast sensitivity; detects 16 levels of gray scale; reliably detects the toughest color mark contrasts, including 20% yellow against white
- Choose from three LED colors: blue, green and white.
- Fast, 50-microsecond response
- Easy push-button programming includes Static TEACH, Static Single-Point TEACH, Dynamic TEACH and Remote TEACH; plus manual sensitivity adjustment
- Non-volatile memory
- Ten-element light bar clearly displays received signal strength
- Fixed-convergent sensing at 10 ±3 mm (0.39" ±0.12"); rectangular sensing image measures 1.2 mm x 3.8 mm (0.05" x 0.15") at 10 mm from the lens
- Rugged zinc alloy die-cast housing with high-quality acrylic lens suitable for food processing applications; rated IP67, NEMA 6
- Analog output value provides an indication of signal strength.
- Choice of integral cable or QD connector models.



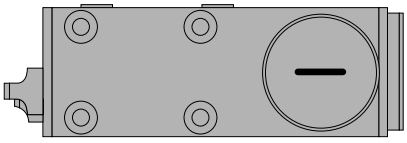
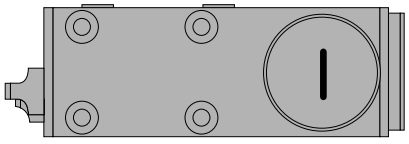
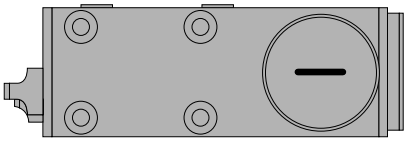
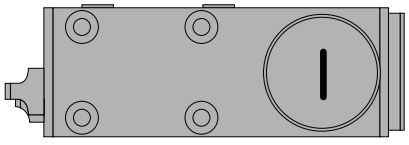
See Sensing Beam Information Below

R55 *Expert* Convergent Mode Sensor Models

Models	Focus	Cable	Supply Voltage	Output Type	Sensing Image Orientation
Visible Green 525 nm					
R55ECG1	10 mm (0.39")	6-wire 2 m (6.5')	10-30V dc	Bipolar NPN/PNP and Analog 0-10 mA	 Parallel to sensor length
R55ECG1Q		6-pin Euro-style QD			
R55ECG2		6-wire 2 m (6.5')			 Perpendicular to sensor length
R55ECG2Q		6-pin Euro-style QD			

See Sensing Beam Information Below

R55 *Expert* Convergent Mode Sensor Models

Models	Focus	Cable	Supply Voltage	Output Type	Sensing Image Orientation
Visible Blue 475 nm					
R55ECB1	10 mm (0.39")	6-wire 2 m (6.5')	10-30V dc	Bipolar NPN/PNP and Analog 0-10 mA	 Parallel to sensor length
R55ECB1Q		6-pin Euro-style QD			
R55ECB2		6-wire 2 m (6.5')			 Perpendicular to sensor length
R55ECB2Q		6-pin Euro-style QD			
Visible White 450-650 nm					
R55ECW1	10 mm (0.39")	6-wire 2 m (6.5')	10-30V dc	Bipolar NPN/PNP and Analog 0-10 mA	 Parallel to sensor length
R55ECW1Q		6-pin Euro-style QD			
R55ECW2		6-wire 2 m (6.5')			 Perpendicular to sensor length
R55ECW2Q		6-pin Euro-style QD			

For R55 *Expert* Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **R55ECG1 W/30**)

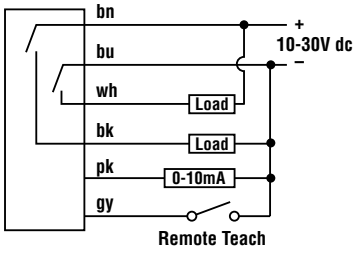
ii) A model with a QD connector requires an accessory mating cable. See page 309 and the Accessories section for more information.

R55 *Expert* Specifications

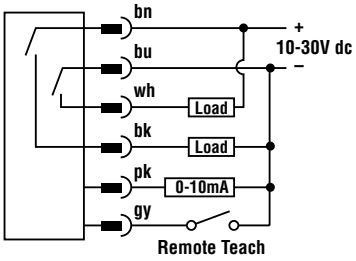
Supply Input	10 to 30V dc (10% maximum ripple) at less than 80 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Digital outputs are bipolar: one current sourcing (PNP) and one current sinking (NPN) open-collector transistor Analog output is a current source which is proportional to the received light level, updated in real time (every 50 microseconds)
Output Rating	Digital outputs are 150 mA maximum (each) **Off-state leakage current:** < 10 microamps at 30V dc **Saturation voltage (NPN output):** < 1.5V at 150 mA dc **Saturation voltage (PNP output):** < 2.0V at 150 mA dc **Current Sourcing Analog output:** 0 to 10 mA **Maximum load voltage drop:** ≤ 2 volts
Output Protection	Protected against false pulse on power-up and continuous overload or short-circuit of outputs.
Output Response	50 microseconds NOTE: 1 second delay on power-up; outputs do not conduct during this time.
Adjustments	**Using push buttons ("+" Dynamic and "-" Static):** Manually adjust discrete output Switch Point using "+" or "-" buttons Dynamic TEACH (teach on-the-fly) sensitivity adjustment Static TEACH sensitivity adjustment Static Single-Point TEACH Light operate/Dark operate OFF Delay select: 0 milliseconds, 20 milliseconds or 40 milliseconds **Using Remote TEACH input (gray wire):** Dynamic TEACH (teach on-the-fly) sensitivity adjustment Static TEACH sensitivity adjustment Static Single-Point TEACH Light operate/Dark operate OFF Delay select: 0 milliseconds, 20 milliseconds or 40 milliseconds Push button lockout for security
Indicator LEDs	10-segment (green) light bar indicates signal strength Light Operate (green) Dark Operate (green) Outputs Conducting (yellow) OFF Delay (green): **SETUP Mode:** OFF — no delay; Flashing — 20 ms delay; ON — 40 ms delay **RUN Mode:** OFF — no delay; ON — 20 or 40 ms Delay
Construction	Zinc alloy die-cast housing with steel cover, both with black acrylic polyurethane finish Lens, lens port cap, Sensitivity control, and Mode switch cap are o-ring sealed Lens is acrylic Lens port cap and lens holder are ABS
Environmental Rating	IEC IP67; NEMA 6
Connections	PVC-jacketed 6-conductor 2 m (6.5') or 9 m (30') attached cable with internal strain relief, or 6-pin Euro-style quick-disconnect. Mating QD cables are purchased separately. See Accessories section, page 309.
Operating Conditions	**Temperature:** -10° to +55° C (+14° to 131° F) **Maximum Relative Humidity:** 90% at 50° C (non-condensing)
Vibration and Mechanical Shock	All models meet IEC 68-2-6 and IEC 68-2-27 testing criteria.
Application Notes	• Do not mount the sensor directly perpendicular to shiny surfaces; position it at approximately a 15° angle in relation to the sensing target. • Minimize web or product "flutter" whenever possible to maximize sensing reliability. • The analog output is proportional to the received light signal. The analog output is unaffected by + or – manual sensitivity adjustments.

R55 *Expert* Hookups

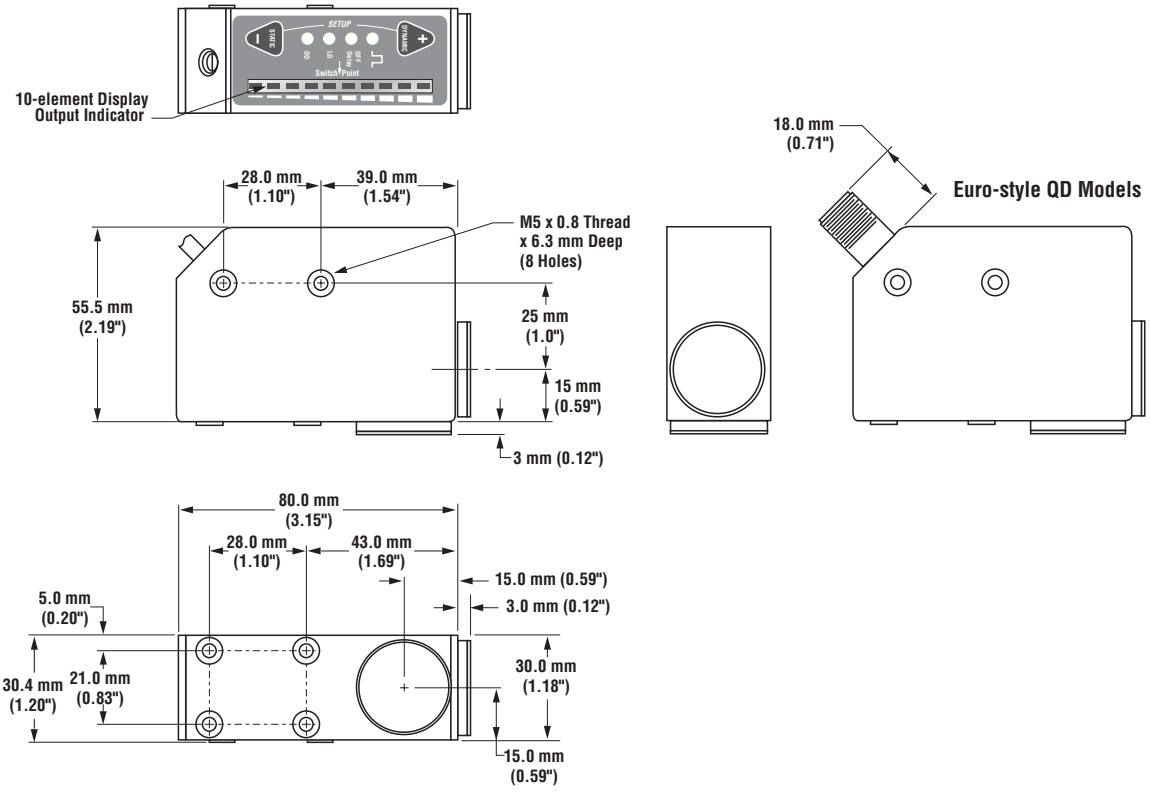
Cabled Models



Quick-Disconnect Models



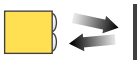
R55 *Expert* Dimensions



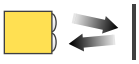
R55 Color Mark Sensors

- Reliably detects the toughest color mark contrasts, including 20% yellow against white
- Totally solid-state, no bulbs to replace and no need to switch between different colored light sources
- 10 to 30V dc operation
- 10-element LED signal strength display for quick, easy setup
- All models offer NPN (sinking) and PNP (sourcing) plus analog output
- Choose models with either horizontal or vertical sensing image (see chart, below)
- 2 m (6.5') integral cable or 5-pin euro-style 300 mm (12") pigtail quick-disconnect; 9 m (30') integral cable is also available

R55 Sensing Mode Options

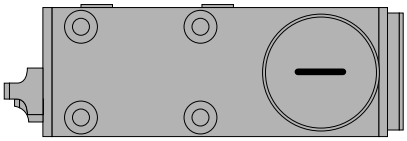
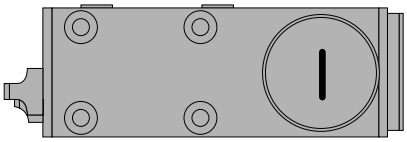


Convergent



Visible blue-green, 525 nm

R55 Convergent Mode with Blue-Green LED

Models	Focus	Cable	Supply Voltage	Output Type	Sensing Image Orientation
R55CG1	10 mm (0.39")	2 m (6.5')	10-30V dc	Bipolar NPN/PNP Analog 0-10 mA	 Parallel to sensor length
R55CG1Q		Integral 5-pin Euro QD			
R55CG1QP		5-pin Euro pigtail QD			
R55CG2		2 m (6.5')			 Perpendicular to sensor length
R55CG2Q		Integral 5-pin Euro QD			
R55CG2QP		5-pin Euro pigtail QD			

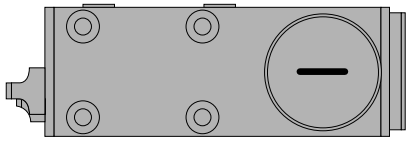
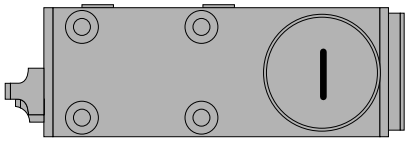
For R55 Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **R55CG1 W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 309 and the Accessories section for more information.

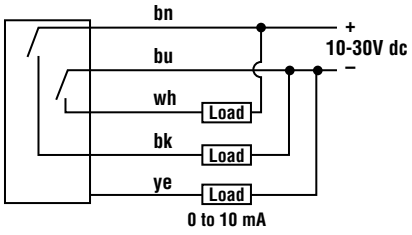
Visible white, 460-550 nm

R55 Convergent Mode with White LED

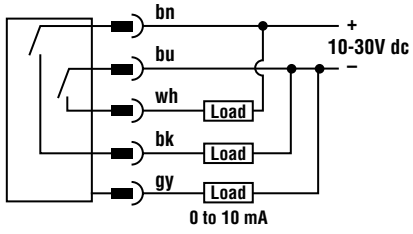
Models	Focus	Cable	Supply Voltage	Output Type	Sensing Image Orientation
R55CW1	10 mm (0.39")	2 m (6.5')	10-30V dc	Bipolar NPN/PNP Analog 0-10 mA	 Parallel to sensor length
R55CW1Q		Integral 5-pin Euro QD			
R55CW1QP		5-pin Euro pigtail QD			
R55CW2		2 m (6.5')			 Perpendicular to sensor length
R55CW2Q		Integral 5-pin Euro QD			
R55CW2QP		5-pin Euro pigtail QD			

R55 Hookup Diagrams

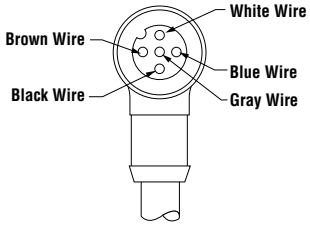
R55 Sensor with Attached Cable



R55 Sensor with Quick-Disconnect



5-Pin Euro-Style Pin-out (Cable Connector Shown)



Quick-Disconnect (QD) Option

R55 sensors are sold with either a 2 m (6.5') attached PVC-covered cable, or with a 5-pin euro-style pigtail QD cable fitting.

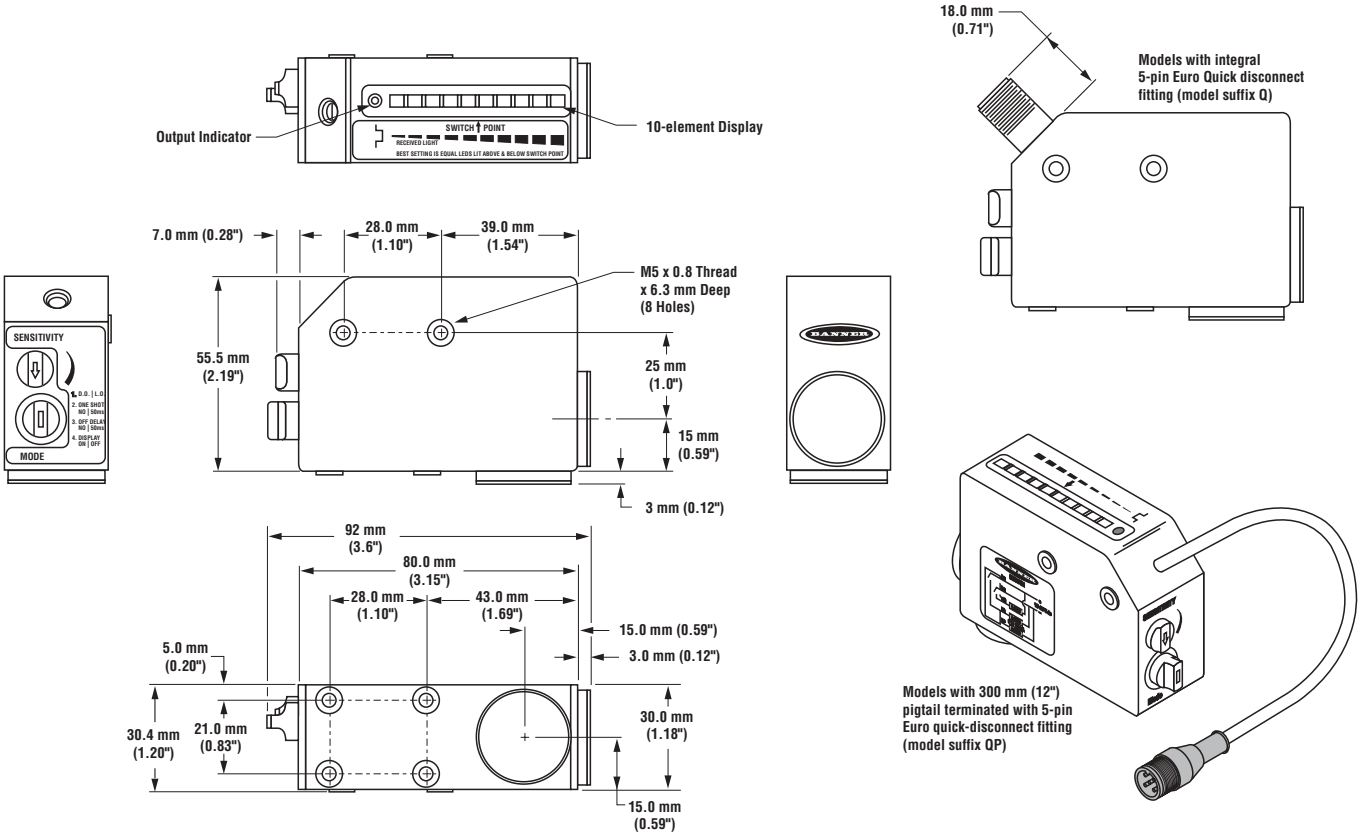
R55 QD sensors are identified by the letter "Q" in their model number suffix. Mating cables for QD R55 sensors are model MQDC1-5xx (straight connector) or MQDC1-5xxRA (right-angled connector). For more information on QD cables see page 309 or Accessories section.

R55 Specifications

Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 70 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Digital outputs are bipolar: one current sourcing (PNP) and one current sinking (NPN) open-collector transistor Analog output is a current source which is proportional to the received light level
Output Rating	Digital outputs are 150 mA maximum (each) **Off-state leakage current** <10 microamps at 30V dc **Saturation voltage** (NPN output) <2.0V at 150 mA dc **Saturation voltage** (PNP output) <1.5V at 150 mA dc Analog output: 0 to 10 mA Maximum load voltage drop is V_{supply} minus 7 volts (3V at $10V_{supply}$; 23V at $30V_{supply}$)
Output Protection Circuitry	All outputs are protected against false pulse on power-up and continuous overload or short circuit of outputs
Output Response Time	<50 microseconds “on” and “off” with no output delay timing selected (NOTE: 100 millisecond delay on power-up: NPN & PNP outputs are non-conducting at this time)
Sensing Image	Rectangular: 1.2 mm x 3.8 mm (0.05" x 0.15") at 10 mm (0.39") from face of lens; image oriented either parallel or perpendicular to sensor length, depending on model (see pages 302 and 303)
Adjustments	15-turn SENSITIVITY control with external knob Four DIP switches select the following functions: Switch #1: Light or dark operate Switch #2: 50 millisecond non-retriggerable one-shot Switch #3: 50 millisecond off delay Switch #2 plus #3: 100 millisecond retriggerable one-shot Switch #4: Enable/disable for 10-element light bar
Indicators	10-element green moving LED light bar displays signal strength, relative to the switch point setting Green LED output indicator
Construction	Zinc alloy diecast housing with steel cover - both with black acrylic polyurethane finish Lens, lens port cap, SENSITIVITY control, and MODE switch cap are o-ring sealed Lens and light bar display window are acrylic Lens port cap and lens holder are ABS MODE switch cap is Delrin® SENSITIVITY control knob is Nylon
Environmental Rating	NEMA 6, IP67
Connections	PVC-jacketed 5-conductor 2 m (6.5') or 9 m (30') attached cable, or 5-pin euro-style quick-disconnect on 300 mm (12") cable pigtail. Mating QD cables are purchased separately. See page 309 and Accessories section.
Operating Conditions	**Temperature:** -10° to +55°C (+14° to 131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Vibration and Mechanical Shock	All models meet IEC 68-2-6 and IEC 68-2-27 testing criteria
Application Notes	Include approximately a 15° angle in sensor mounting when sensing color marks on shiny materials (i.e. do not mount sensor exactly perpendicular to shiny material surfaces) Minimize web or product “flutter”, whenever possible, for greatest sensing reliability
Certifications	CE c UL us

Delrin® is a registered trademark of Dupont Co.

R55 Dimensions

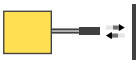


R55 Fiber-Optic Color Mark Sensors

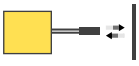
For Plastic and Glass Fiber Optics

- Outstanding color contrast sensitivity; detects 16 levels of gray scale; depending on beam color, reliably detects the toughest color mark contrasts, including 20% yellow against white
- Fast, 50-microsecond response
- Choose from four beam colors: infrared, visible red, blue, green and white
- Fibers mount in small and otherwise inaccessible areas
- Easy push-button programming includes Static TEACH, Static Single-Point TEACH, Dynamic TEACH and Remote TEACH; plus manual sensitivity adjustment
- Non-volatile memory
- Fibers install quickly without tools
- Bipolar (NPN/PNP) outputs with three Delay settings (0, 20 or 40 milliseconds)
- Choice of integral cable or QD connector models
- Mounts flat or to 35 mm DIN rail; two brackets included with sensor (one for angle mount, one for flat mount)

R55 Fiber Optic Sensing Mode Options



Glass and Plastic Fiber Optic

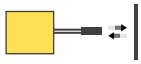


See Sensing Beam Information Below

R55F Glass Fiber-Optic Sensor Models

Models	Maximum Sensing Distance For black-to-white contrast	Cable*	Supply Voltage	Output Type
Infrared 880 nm			10-30V dc	Bipolar NPN/PNP
R55F	0.060" dia. Bundle: 40 mm (1.6") 0.125" dia. Bundle: 140 mm (5.5")	5-wire 2 m (6.5')		
R55FQ		5-pin Euro-style QD		
Visible Red 650 nm				
R55FV	0.060" dia. Bundle: 28 mm (1.1") 0.125" dia. Bundle: 110 mm (4.3")	5-wire 2 m (6.5')		
R55FVQ		5-pin Euro-style QD		
Visible Green 525 nm				
R55FVG	0.060" dia. Bundle: 12 mm (0.5") 0.125" dia. Bundle: 50 mm (2.0")	5-wire 2 m (6.5')		
R55FVGQ		5-pin Euro-style QD		
Visible Blue 475 nm				
R55FVB	0.060" dia. Bundle: 12 mm (0.5") 0.125" dia. Bundle: 50 mm (2.0")	5-wire 2 m (6.5')		
R55FVBQ		5-pin Euro-style QD		
Visible White 450-650 nm				
R55FVW	0.060" dia. Bundle: 12 mm (0.5") 0.125" dia. Bundle: 50 mm (2.0")	5-wire 2 m (6.5')		
R55FVWQ		5-pin Euro-style QD		

* 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **R55VW W/30**)

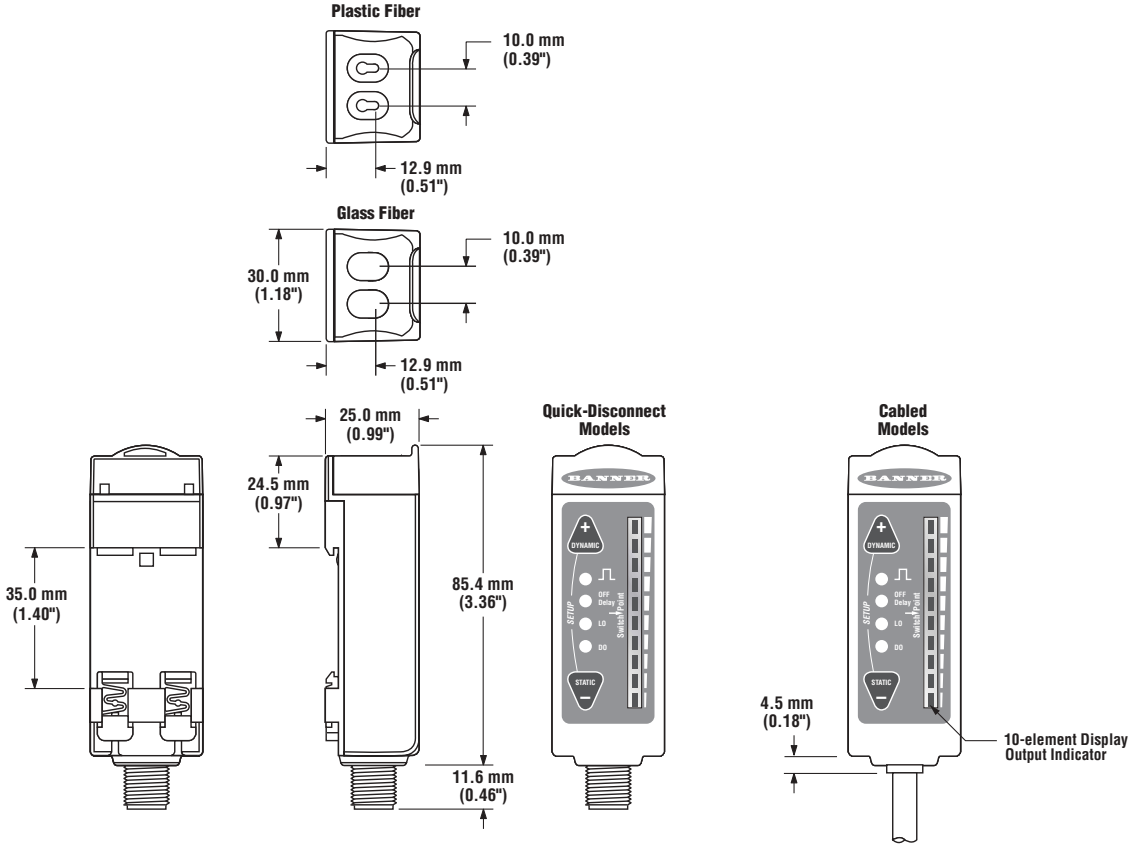


See Sensing Beam Information Below

R55F Plastic Fiber-Optic Sensor Models

Models	Maximum Sensing Distance For black-to-white contrast	Cable	Supply Voltage	Output Type
Visible Red 650 nm			10-30V dc	Bipolar NPN/PNP
R55FP	0.040" dia. Fibers: 60 mm (2.4")	5-wire 2 m (6.5')		
R55FPQ		5-pin Euro-style QD		
Visible Green 525 nm				
R55FPG	0.040" dia. Fibers: 28 mm (1.1")	5-wire 2 m (6.5')		
R55FPGQ		5-pin Euro-style QD		
Visible Blue 475 nm				
R55FPB	0.040" dia. Fibers: 28 mm (1.1")	5-wire 2 m (6.5')		
R55FPBQ		5-pin Euro-style QD		
Visible White 450-650 nm				
R55FPW	0.040" dia. Fibers: 28 mm (1.1")	5-wire 2 m (6.5')		
R55FPWQ		5-pin Euro-style QD		

R55 Fiber-Optic Dimensions

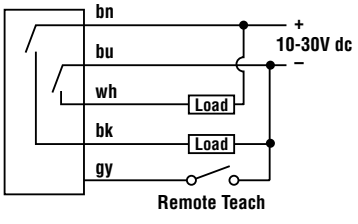


R55 Fiber-Optic Specifications

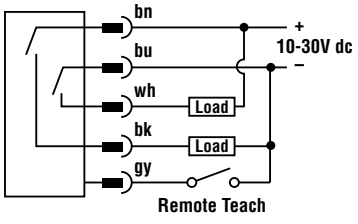
Supply Input	10 to 30V dc (10% maximum ripple) at less than 70 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar (NPN and PNP)
Output Rating	150 mA max each output @ 25°C (derate ≈ 1 mA per °C increase) **OFF-state leakage current:** < 5 µA @ 30V dc **ON-state saturation voltage:** PNP Output < 1V @ 10 mA and 1.5V @ 150 mA NPN Output < 200 mV @ 10 mA and 1V @ 150 mA
Output Protection	Protected against false pulse on power-up and continuous overload or short-circuit of outputs.
Output Response	50 microseconds NOTE: 100 millisecond delay on power-up; outputs do not conduct during this time.
Adjustments	**Using push buttons ("+" Dynamic and "-" Static):** Manually adjust Switch Point using "+" or "-" buttons Dynamic TEACH (teach on-the-fly) sensitivity adjustment Static TEACH sensitivity adjustment Static Single-Point TEACH Light operate/Dark operate OFF Delay select: 0 milliseconds, 20 milliseconds or 40 milliseconds **Using Remote TEACH input (gray wire):** Dynamic TEACH (teach on-the-fly) sensitivity adjustment Static TEACH sensitivity adjustment Static Single-Point TEACH Light operate/Dark operate OFF Delay select: 0 milliseconds, 20 milliseconds or 40 milliseconds Push button lockout for security
Indicator LEDs	10-segment (green) light bar indicates signal strength Light Operate (green) Dark Operate (green) Outputs Conducting (yellow) OFF Delay (green): **SETUP Mode:** OFF — no delay; Flashing — 20 ms delay; ON — 40 ms delay **RUN Mode:** OFF — no delay; ON — 20 or 40 ms Delay
Construction	**Housing:** Black ABS/polycarbonate blend; nylon fiber clip mounts to standard 35 mm DIN rail 1 stainless steel right angle bracket and 1 PBT polyester bracket for mounting to flat surfaces also included with sensor
Environmental Rating	IEC IP67; NEMA 6
Connections	**Power:** 2 m or 9 m PVC-jacketed 5-conductor cable or 5-pin Euro-style quick-disconnect (QD) connector **Fibers:** Fiber clip (no tool required)
Operating Conditions	**Temperature:** -10° to +55° C (+14° to 131° F) **Maximum Relative Humidity:** 90% at 50° C (non-condensing)
Application Notes	• Do not mount the fiber tip directly perpendicular to shiny surfaces; position it at approximately a 15° angle in relation to the sensing target • Minimize web or product "flutter" whenever possible to maximize sensing reliability

R55F Hookups

Cabled Models



Quick-Disconnect Models



Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All R55 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	**R55CG1 W/30**

Quick-Disconnect (QD) Cables

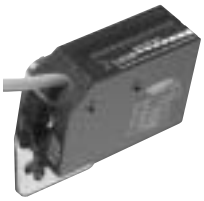
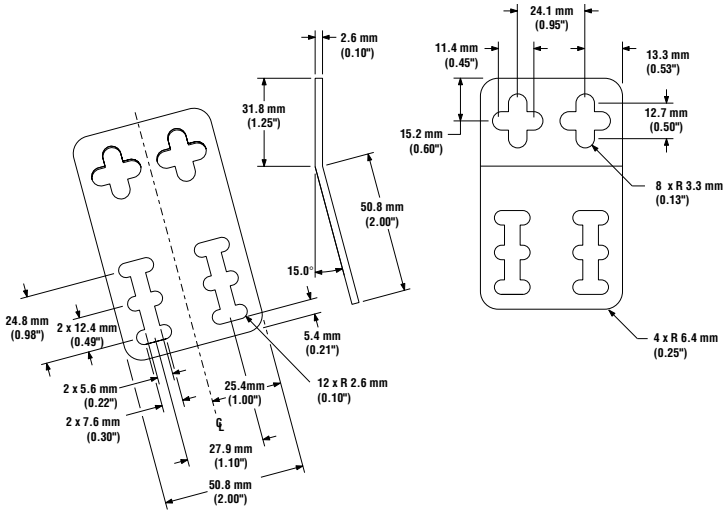
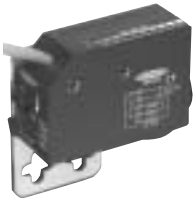
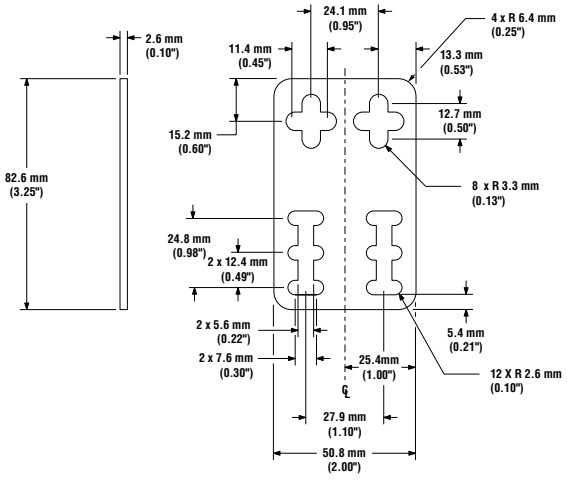
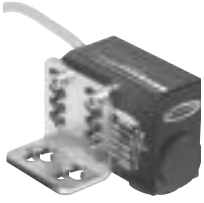
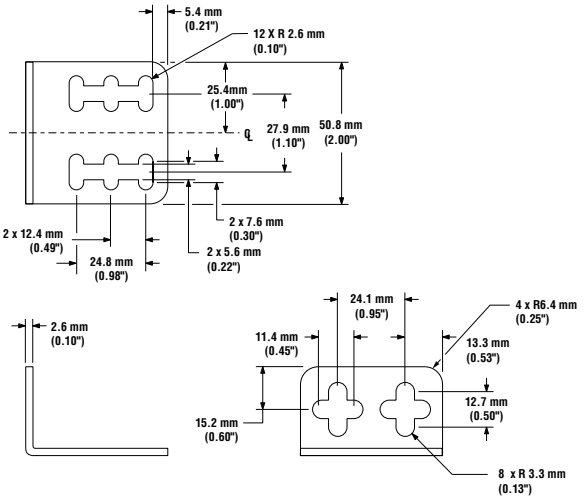
Following is the selection of cables available for R55 QD models. See the Accessories section for more cable information.

Style	Model	Length	Connector	Used with:
5-Pin Euro	**MQDC1-506**	2 m (6.5')	Straight	All R55 and R55F Series sensors with QD fitting
	MQDC1-515	5 m (15')	Straight	
	MQDC1-530	9 m (30')	Straight	
	MQDC1-506RA	2 m (6.5')	Right-angle	
	MQDC1-515RA	5 m (15')	Right-angle	
	MQDC1-530RA	9 m (30')	Right-angle	
6-Pin Euro	**MQDC-606**	2 m (6.5')	Straight	All R55 Expert sensors with QD fitting
	MQDC-615	5 m (15')	Straight	
	MQDC-630	9 m (30')	Straight	
	MQDC-606RA	2 m (6.5')	Right-angle	
	MQDC-615RA	5 m (15')	Right-angle	
	MQDC-630RA	9 m (30')	Right-angle	

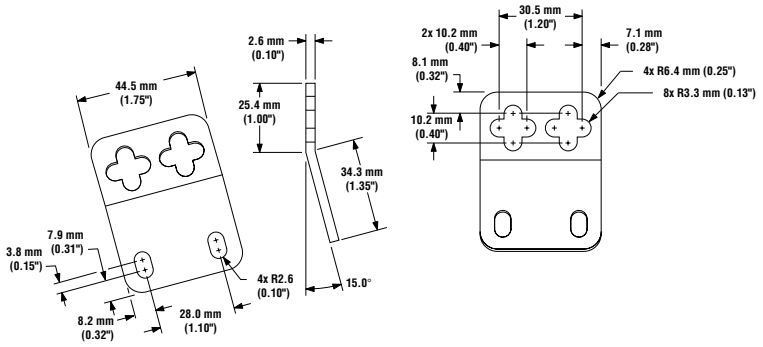
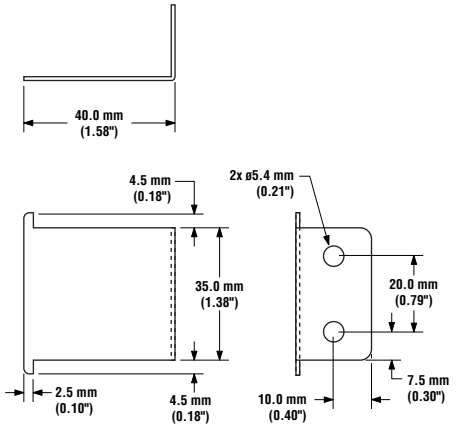
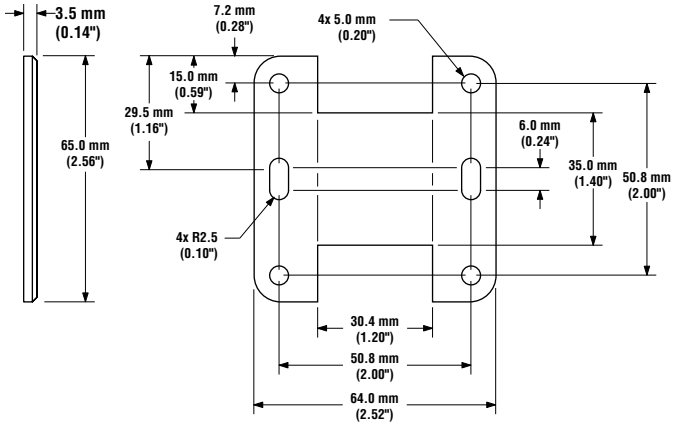
Replacement Lens

Models	Description	
UC-R55	Replacement lens for R55 or R55E	

Mounting Brackets

Model	Description	Dimensions
SMB55A 	• 15° offset bracket • 12-gauge stainless steel	
SMB55F 	• Flat mount bracket • 12-gauge stainless steel	
SMB55RA 	• Right-angle bracket • 12-gauge stainless steel	

Mounting Brackets

Model	Description	Dimensions
SMB55S 	• 15° offset bracket • 12-gauge stainless steel	
SMBR55FRA 	• For use with R55F sensors • Side-mounting bracket • 19-gauge stainless steel • Included with sensor	
SMBR55F01 	• For use with R55F sensors • Flat-mounting bracket • Molded PBT polyester • Included with sensor	

NOTES:

Slot Sensors

Slot sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

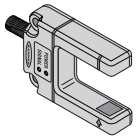
SL30 Series Slot Sensors

For Color Mark Sensing on Clear Films, Plus Many Other Applications

- Easy-to-use self-contained opposed-mode sensor pair in a rugged U-shaped housing
- Easy and economical to mount
- Molded-in beam guides simplify mounting and beam placement
- 30 mm slot width for a wide variety of sensing applications
- Applications include label detection, clear film registration, hole detection, gear tooth detection, edge guiding and counting
- 2 mm effective beam
- 10 to 30V dc operation
- Bipolar PNP/NPN outputs
- Dark or light operate
- Choose integral, unterminated cable or QD models
- *Expert*™ models have:
  - Easy push-button programming which automatically adjusts sensitivity to optimal setting
  - Separate TEACH input allows remote programming by an external device, such as a switch or a process controller
  - Fast 500 microsecond or 150 microsecond output response

SL30 Series Sensors Sensing Mode Options

Opposed



Visible red, 680 nm

SL30 Series Slot Sensor with 4-turn Sensitivity Adjustment

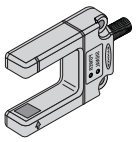
Models	Slot Width	Cable	Supply Voltage	Output Type	Response	Repeatability
SL30VB6V	30 mm (1.2")	5-wire 2 m (6.5') cable	10-30V dc	Bipolar NPN (sinking) and PNP (sourcing)	1 millisecond	250 microseconds
SL30VB6VQ		5-Pin Euro-style QD				
SL30VB6VY		5-wire 2 m (6.5') cable			300 microseconds	75 microseconds
SL30VB6VYQ		5-Pin Euro-style QD				

For All SL30 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SL30VB6V W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 325 and the Accessories section for more information.

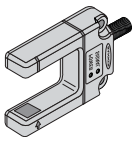
Infrared, 890 nm



SLO30 Series Slot Sensor with Fixed Sensitivity

Models	Slot Width	Cable	Supply Voltage	Output Type	Response	Repeatability
SLO30VB6	30 mm (1.2")	5-wire 2 m (6.5') cable	10-30V dc	Bipolar NPN (sinking) and PNP (sourcing)	1 millisecond	250 microseconds
SLO30VB6Q		5-Pin Euro-style QD				
SLO30VB6Y		5-wire 2 m (6.5') cable			300 microseconds	75 microseconds
SLO30VB6YQ		5-Pin Euro-style QD				

Visible red, 680 nm

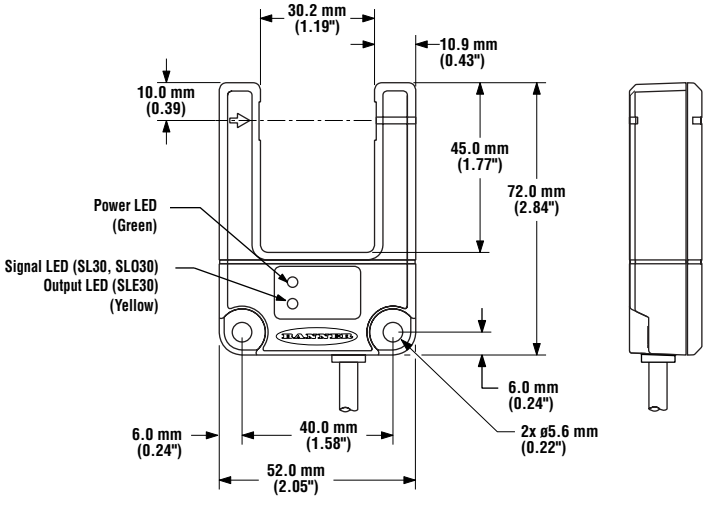


SLE30 *Expert*™ Series Slot Sensor with Push-button TEACH mode Sensitivity

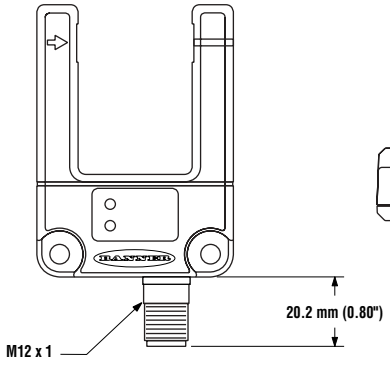
Models	Slot Width	Cable	Supply Voltage	Output Type	Response	Repeatability
SLE30B6V	30 mm (1.2")	5-wire 2 m (6.5') cable	10-30V dc	Bipolar NPN (sinking) and PNP (sourcing)	500 microseconds	100 microseconds
SLE30B6VQ		5-Pin Euro-style QD				
SLE30B6VY		5-wire 2 m (6.5') cable			150 microseconds	75 microseconds
SLE30B6VYQ		5-Pin Euro-style QD				

SL30, SLO30 and SLE30 Series Slot Sensor Dimensions

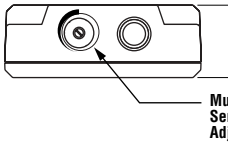
Cabled



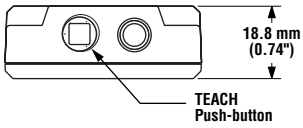
Quick-Disconnect



Back View SL30 Models



SLE30 *Expert* Models



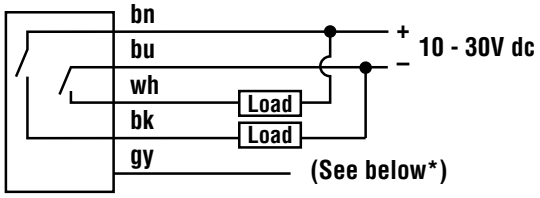
NOTE: SLO Series have no sensitivity adjustment

SL30 & SLO30 Series Slot Sensor Specifications

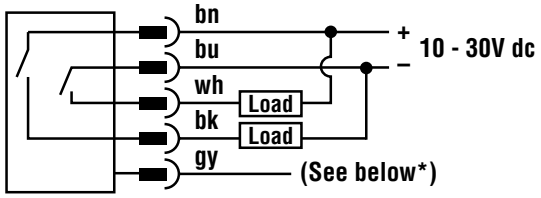
Supply Voltage and Current	10 to 30V dc, 30 mA
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: NPN (current sinking) and PNP (current sourcing)
Output Rating	150mA, each output
Output Protection Circuitry	Protected against false pulse on power-up and short-circuit of outputs
Output Response Time	1 millisecond or 300 microseconds, depending on model
Repeatability	250 microseconds or 75 microseconds, depending on model
Adjustments	SL30 Series: 4-turn clutched potentiometer sensitivity adjustment SLO30 Series: None
Indicators	**Green:** Power ON/OFF indicator **Yellow:** Signal Condition indicator
Construction	**Housing:** ABS/polycarbonate **Lenses:** Acrylic
Environmental Rating	IP67, NEMA 6
Connections	2 m (6.5') or 9 m (30') 5-conductor PVC-jacketed attached cable or 5-pin Euro-style quick-disconnect (QD) connector. QD cables are ordered separately. See page 325.
Operating Conditions	**Operating Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% @ 50°C (non-condensing)

SL30 & SLO30 Series Slot Sensor Hookup Diagrams

Cabled models

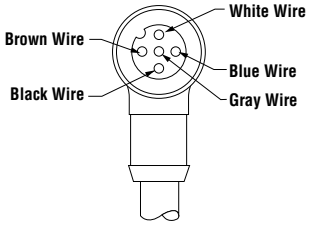


Quick-disconnect models



* For Dark Operate, connect gray wire to + (brown).
For Light Operate, connect gray wire to – (blue) or leave circuit open.

5-Pin Euro-Style Pin-out (Cable Connector Shown)

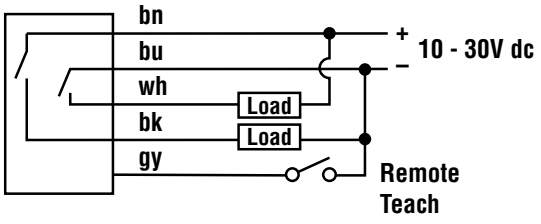


SLE30 *Expert*™ Series Slot Sensor Specifications

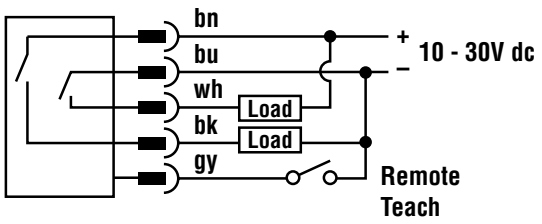
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 45 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	150mA maximum each output at 25°C, derated to 100 mA at 70°C (derate ≈1 mA per °C) **OFF-state leakage current:** less than 5µA @ 30V dc **ON-state saturation current:** less than 1V @ 10 mA; less than 1.5V @ 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Output Response Time	Sensors will respond to either a "light" or a "dark" signal of 500 microseconds (or 150 microseconds, depending on model) or longer duration, 1 kHz max. NOTE: 1 second delay on power-up; outputs are non-conducting during this time.
Repeatability	100 microseconds or 75 microseconds, depending on model
Adjustments	Push-button TEACH mode sensitivity setting; remote TEACH mode input is provided (gray wire)
Indicators	Two LEDs: Yellow and Bi-color Green/Red **Green (RUN Mode):** ON when power is applied Flashes when received light level approaches the switching threshold **Red (TEACH Mode):** OFF when no signal is received. Pulses to indicate signal strength (received light level). Rate is proportional to signal strength (the stronger the signal, the faster the pulse rate). This is a function of Banner's patented Alignment Indicating Device (AID™, US patent 4356393). **Yellow (TEACH Mode):** ON to indicate sensor is ready to learn output ON condition OFF to indicate sensor is ready to learn output OFF condition **Yellow (RUN Mode):** ON when outputs are conducting
Construction	**Housing:** ABS/polycarbonate **Lenses:** Acrylic
Environmental Rating	Meets NEMA 6; IEC IP67
Connections	PVC-jacketed 5-conductor 2 m (6.5') or 9 m (30') unterminated cable, or 5-pin Euro-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 325.
Operating Conditions	**Temperature:** -20° to +70°C (-4° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	The first condition presented during TEACH mode becomes the output ON condition.

SLE30 *Expert*™ Series Slot Sensor Hookup Diagrams

Cabled Models



Quick-Disconnect Models

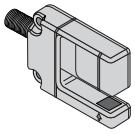


SL10 Series Slot Sensors

- An easy-to-use self-contained opposed-mode sensor pair in a rugged U-shaped housing
- Easy and economical to mount
- Molded-in beam guides simplify mounting and beam placement
- 10 mm slot width for a wide variety of sensing applications
- Applications include label detection, hole detection, gear tooth detection, edge guiding, parts detection and counting
- 2 mm effective beam on SL10 models and 1 mm effective beam on SLE10 models
- 10 to 30V dc operation
- Bipolar PNP/NPN outputs
- Visible red beam
- Dark or light operate
- Choose integral, unterminated cable or QD models
- *Expert*™ models have:
  - Easy push-button programming which automatically adjusts sensitivity to optimal setting
  - Separate TEACH input allows remote programming by an external device, such as a switch or a process controller
  - Fast 500 microsecond or 150 microsecond output response

SL10 Series Sensors Sensing Mode Options

Opposed



Visible red, 680 nm

SL10 Series Slot Sensor with 4-turn Sensitivity Adjustment

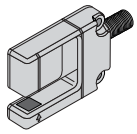
Models	Slot Width	Cable	Supply Voltage	Output Type	Response	Repeatability
SL10VB6V	10 mm (0.4")	5-wire 2 m (6.5') cable	10-30V dc	Bipolar NPN (sinking) and PNP (sourcing)	1 millisecond	250 microseconds
SL10VB6VQ		5-Pin Euro-style QD				
SL10VB6VY		5-wire 2 m (6.5') cable			300 microseconds	75 microseconds
SL10VB6VYQ		5-Pin Euro-style QD				

For All SL10 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SL10VB6V W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 325 and the Accessories section for more information.

Visible red, 680 nm

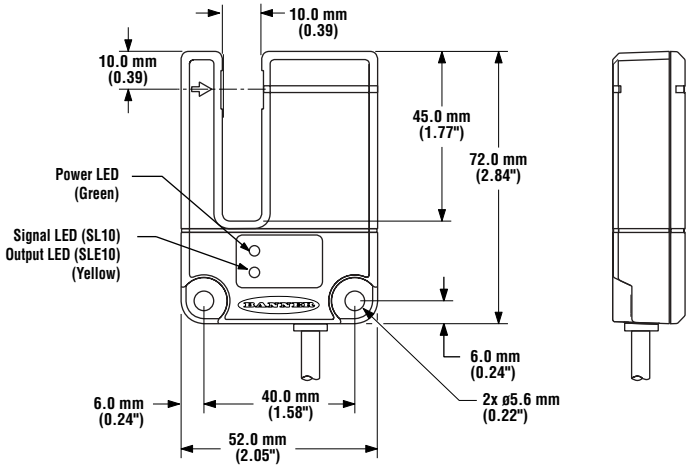


SLE10 *Expert*™ Series Slot Sensor with Push-button TEACH mode Sensitivity

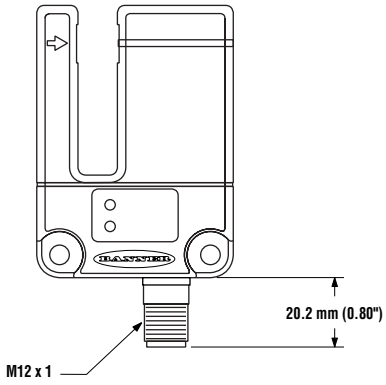
Models	Slot Width	Cable	Supply Voltage	Output Type	Response	Repeatability
SLE10B6V	10 mm (0.4")	5-wire 2 m (6.5') cable	10-30V dc	Bipolar NPN (sinking) and PNP (sourcing)	500 microseconds	100 microseconds
SLE10B6VQ		5-Pin Euro-style QD				
SLE10B6VY		5-wire 2 m (6.5') cable			150 microseconds	75 microseconds
SLE10B6VYQ		5-Pin Euro-style QD				

SL10 and SLE10 Series Slot Sensor Dimensions

Cabled

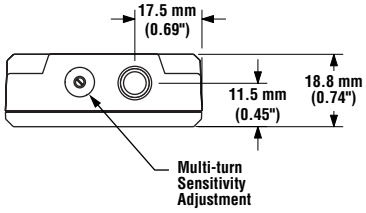


Quick-Disconnect

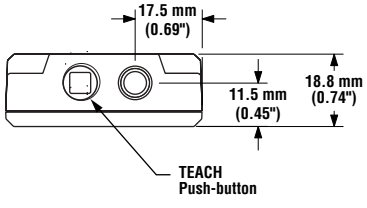


Back View

SL10 Models



SLE10 *Expert* Models

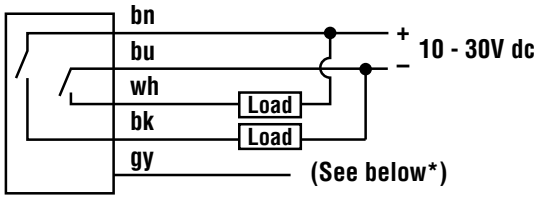


SL10 Series Slot Sensor Specifications

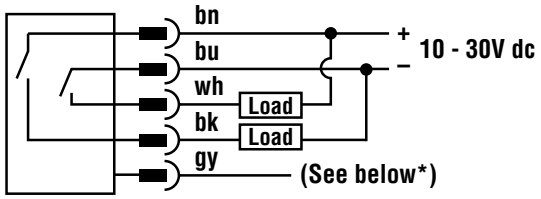
Supply Voltage and Current	10 to 30V dc (10% maximum ripple), 30 mA
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: NPN (current sinking) and PNP (current sourcing)
Output Rating	150mA, each output
Output Protection Circuitry	Protected against false pulse on power-up and short-circuit of outputs
Output Response Time	1 millisecond or 300 microseconds, depending on model NOTE: 100 microsecond delay on power-up; outputs do not conduct during this time
Repeatability	250 microseconds or 75 microseconds, depending on model
Adjustments	4-turn clutched potentiometer sensitivity adjustment
Indicators	**Green:** Power ON/OFF indicator **Yellow:** Signal Condition indicator
Construction	**Housing:** ABS/polycarbonate blend thermoplastic **Lenses:** Acrylic
Environmental Rating	IP67, NEMA 6
Connections	2 m (6.5') or 9 m (30') 5-conductor PVC-jacketed attached cable or 5-pin Euro-style quick-disconnect (QD) connector. QD cables are ordered separately. See page 325.
Operating Conditions	**Operating Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% @ 50°C (non-condensing)

SL10 Series Slot Sensor Hookup Diagrams

Cabled models

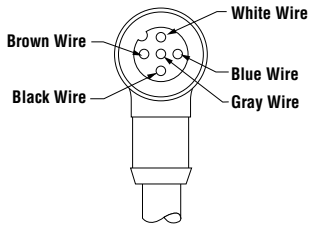


Quick-Disconnect models



* For Dark Operate, connect gray wire to + (brown).
For Light Operate, connect gray wire to – (blue) or leave circuit open.

5-Pin Euro-Style Pin-out (Cable Connector Shown)

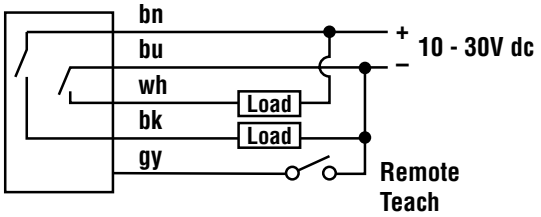


SLE10 *Expert* Series Slot Sensor Specifications

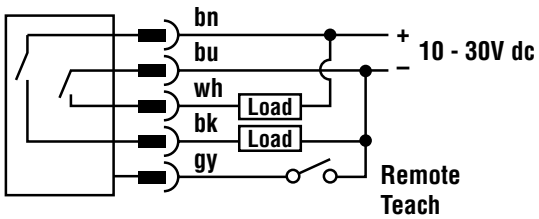
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 45 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	150mA maximum each output at 25°C, derated to 100 mA at 70°C (derate ≈1 mA per °C) **OFF-state leakage current:** less than 5µA @ 30V dc **ON-state saturation current:** less than 1V @ 10 mA; less than 1.5V @ 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Output Response Time	Sensors will respond to either a "light" or a "dark" signal of 500 microseconds (or 150 microseconds, depending on model) or longer duration, 1 kHz max. NOTE: 1 second delay on power-up; outputs are non-conducting during this time.
Repeatability	100 microseconds or 75 microseconds, depending on model
Adjustments	Push-button TEACH mode sensitivity setting; remote TEACH mode input is provided (gray wire)
Indicators	Two LEDs: Yellow and Bi-color Green/Red **Green (RUN Mode):** ON when power is applied Flashes when received light level approaches the switching threshold **Red (TEACH Mode):** OFF when no signal is received. Pulses to indicate signal strength (received light level). Rate is proportional to signal strength (the stronger the signal, the faster the pulse rate). This is a function of Banner's patented Alignment Indicating Device (AID™, US patent 4356393). **Yellow (TEACH Mode):** ON to indicate sensor is ready to learn output ON condition OFF to indicate sensor is ready to learn output OFF condition **Yellow (RUN Mode):** ON when outputs are conducting
Construction	ABS/polycarbonate housing, acrylic lenses
Environmental Rating	Meets NEMA 6; IEC IP67
Connections	PVC-jacketed 5-conductor 2 m (6.5') or 9 m (30') unterminated cable, or 5-pin Euro-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 325.
Operating Conditions	**Temperature:** -20° to +70°C (-4° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	The first condition presented during TEACH mode becomes the output ON condition.

SLE10 *Expert*™ Series Slot Sensor Hookup Diagrams

Cabled Models



Quick-Disconnect Models



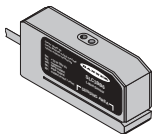
C-GAGE® SLC1 Series Label Sensors

Featuring Adaptive Digital Logic (ADL™)

† Patent Pending

- No user adjustments – Adaptive Digital Logic (ADL™)† provides revolutionary self-learning capability.
- Continuous automatic internal adjustment of sensing threshold and drift compensation.
- Registration accuracy of ± 0.3 mm (0.012")
- Maximum web speed of 10 m per second (33' per second)
- Reliably detects the presence of most types of labels on web backing
  - Clear labels on an opaque backing
  - Clear labels on a clear backing
  - Opaque labels on an opaque backing
  - Opaque labels on a clear backing
- Heavy-duty metal housing, 1 mm (0.04") slot

NOTE: Labels with metallic or carbon-based inks, foil embossing or metal substrates are not recommended for use with SLC1 Series sensors.



SLC1 Series Label Sensor

Models	Slot Width	Cable	Supply Voltage	Output Type	Response	User Adjustments
SLC1BB6	1 mm (0.04")	5-wire 2 m (6.5') cable	10-30V dc	Bipolar (NPN and PNP)	100 microseconds	None Required
SLC1BB6Q		5-Pin Euro-style QD				

For SLC1 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SLC1BB6 W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 325 and the Accessories section for more information.

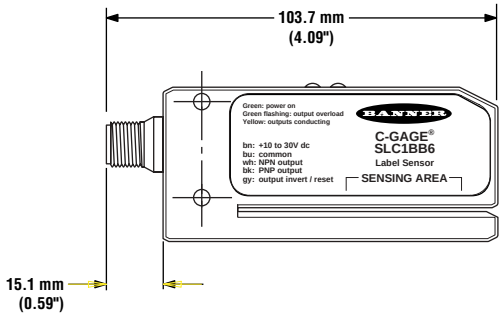
SLC1 Series Specifications

Supply Voltage and Current	10 to 30V dc (10% max. ripple) @ less than 60 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Power-Up or Reset Delay	1 second typical (outputs are non-conducting during this time)
Output Configuration	Bipolar: one current-sourcing (PNP) and one current-sinking (NPN) open-collector transistor
Output Rating	150 mA max. (each output) **OFF-state leakage current:** < 5 microamps @ 30V dc **Output saturation voltage:** < 1V @ 10 milliamps dc; < 1.6V @ 150 milliamps dc
Output Protection	Protected against continuous overload and short-circuit of outputs **Overload trip point:** > 200 milliamps, typical, at 20°C
Output Invert Control/Reset	Gray wire has dual functionality, and may be controlled by a PLC **Input impedance:** 10 KΩ **Outputs ON during gap (turn OFF at leading edge of label):** leave open, or connect to 0 to +1V dc **Outputs ON during label (turn ON at leading edge of label):** connect to +5 to 30V dc **Microprocessor reset:** toggle gray wire to opposite polarity for > 100 milliseconds (see Hookups, page 324)
Registration Accuracy*	±0.3 mm (0.012")
Maximum Web Speed*	10 m per second (33' per second)
Response Time*	100µs
Maximum Switching Speed*	1 kHz
Minimum Gap or Label Size	2 mm (0.080")
Adjustments	No user adjustments; automatic continuous adjustment of sensing threshold and drift compensation under internal microprocessor control
Indicators	**Two LEDs, green and yellow:** **Green ON steadily:** power to sensor is ON **Green flashing @ 4 Hz:** output is overloaded **Yellow ON steadily:** NPN and PNP outputs are ON **Green and Yellow flashing alternately @ 1 Hz:** internal error; reset sensor
Construction	Housings are machined aluminum with black anodized finish
Environmental Rating	IP67, NEMA 6
Connections	2 m (6.5') or 9 m (30") 5-wire attached cable, or 5-pin Euro-style quick-disconnect fitting; cables for QD models are purchased separately, see page 325.
Operating Conditions	**Temperature:** +5° to 50°C (+41° to 122°F) **Maximum relative humidity:** 90% at 50°C, non-condensing
Certifications	CE UL Approval in process

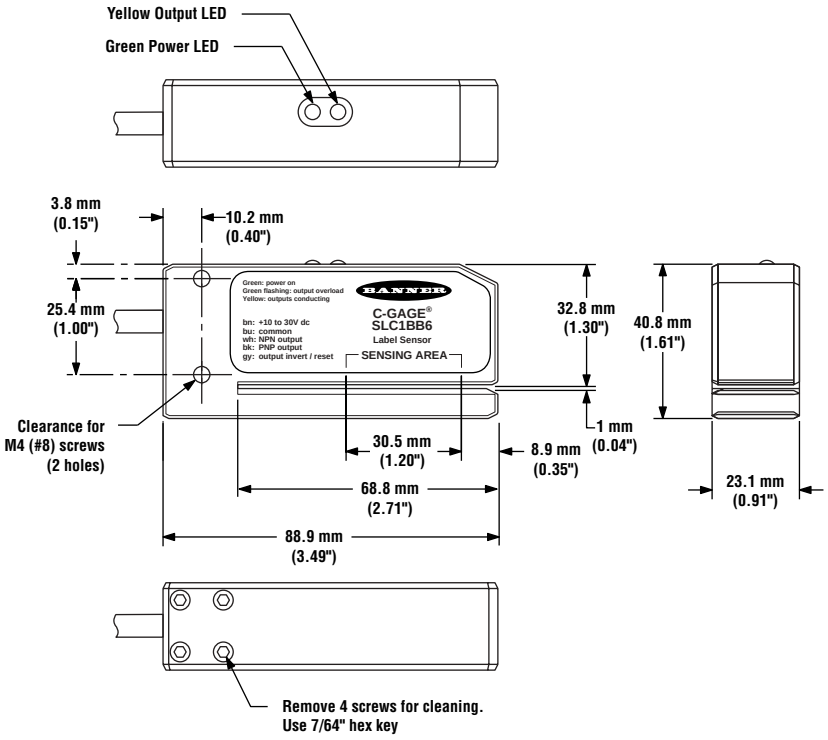
*Based on 3.2 mm (0.125") gap between labels, and web speeds of up to 10 m per second (33' per second). Instantaneous web speed, not average web speed, must be used to determine actual operating speeds in stepped-advance label systems.

SLC1 Series Dimensions

SLC1 with Quick-Disconnect

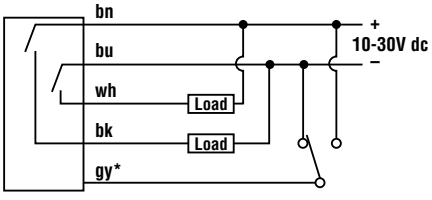


SLC1 with Cable

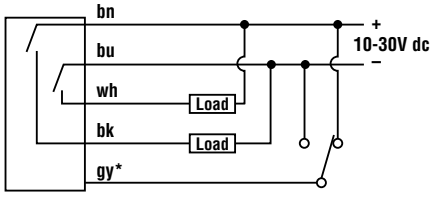


SLC1 Series Hookups

Outputs ON during gap (Turn OFF at leading edge of label)



Outputs ON during label (Turn ON at leading edge of label)



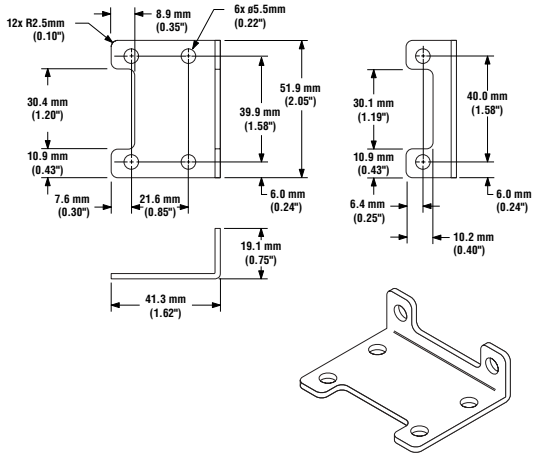
*Toggle to opposite polarity for > 100 milliseconds to reset microprocessor

Quick-Disconnect (QD) Cables

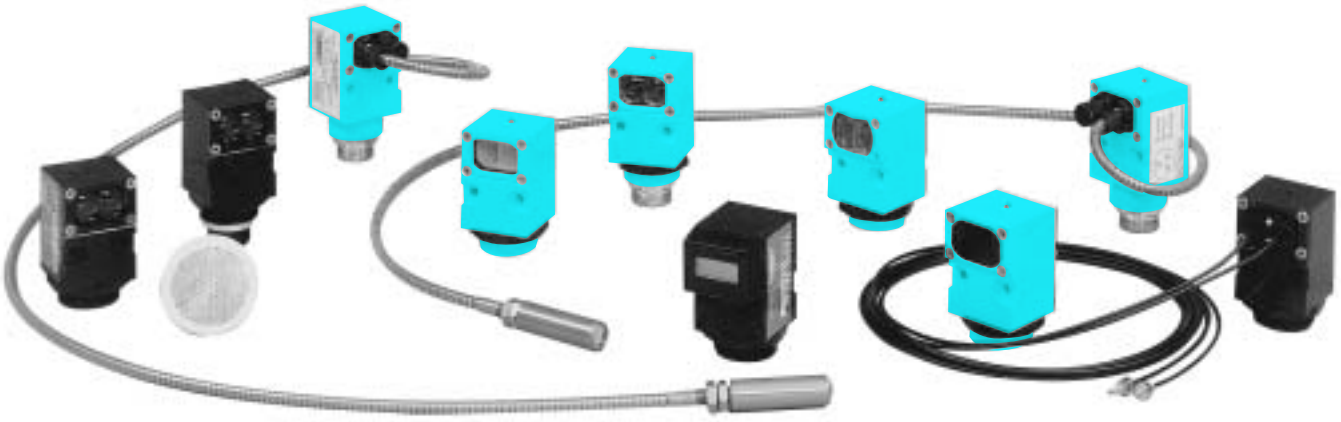
Following is the selection of cables available for SL Series Slot Sensor QD models. See the Accessories section for more cable information.

Style	Model	Length	Connector	Used with:
5-Pin Euro	**MQDC1-506** **MQDC1-515** **MQDC1-530**	2 m (6.5') 5 m (15') 9 m (30')	Straight	All SL10, SL30 and SLC1 Series Slot Sensors with QD fitting
	MQDC1-506RA **MQDC1-515RA** **MQDC1-530RA**	2 m (6.5') 5 m (15') 9 m (30')	Right-angle	

Mounting Brackets

Model	Description	Dimensions
SMBSL 	• For use with SL, SLE and SLO Series slot sensors • Angled bracket • 304 stainless steel; hardware included	

NOTES:



VALU-BEAM® Sensors

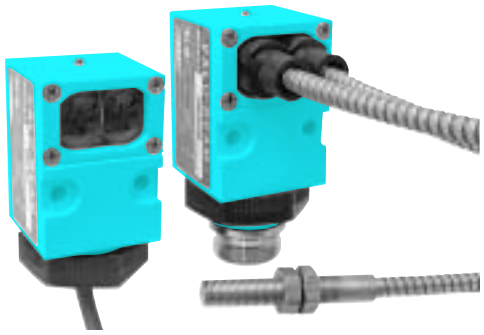
(Exceptions noted)

VALU-BEAM sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

VALU-BEAM 912 Series Sensors

With Solid-State Outputs

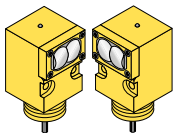
VALU-BEAM 912 cabled diffuse mode (left) and quick-disconnect glass fiber optic mode (right) shown



- Choose models for 10 to 30V dc or 24 to 250V ac operation
- DC models have bipolar solid-state outputs: one NPN (sinking) and one PNP (sourcing)
- AC models have a SPST solid-state output rated for up to 3/4 amp with simple 2-wire hookup
- All models have a rear panel sensitivity adjustment and light/dark operate switch
- DC models include Banner's exclusive† Alignment Indicating Device system (AID™)
- Choose models with integral 2 m (6.5') cable or mini-style QD (quick-disconnect) connector; 9 m (30') cables are also available

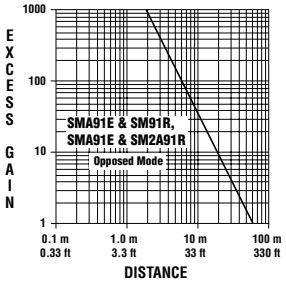
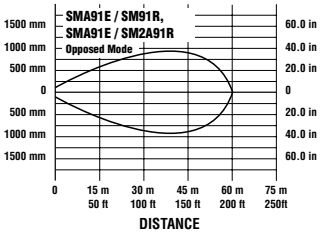
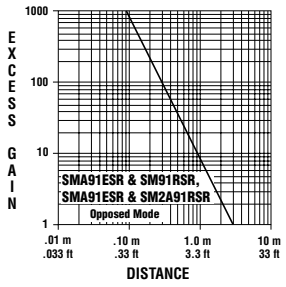
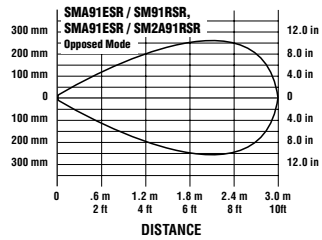
† U. S. Patent #4356393

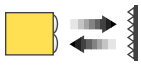
912 Series Sensing Mode Options



Infrared, 880 nm

912 Series Opposed Mode Emitter (E) and Receiver (R)

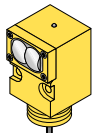
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMA91E **SM91R** **SMA91EQD** **SM91RQD**	60 m (200')	2 m (6.5') 2 m (6.5') 3-Pin Mini QD 4-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 10-30V dc	Bipolar NPN/PNP		Effective Beam: 13 mm 
SMA91E **SM2A91R** **SMA91EQD** **SM2A91RQD**		2 m (6.5') 2 m (6.5') 3-Pin Mini QD 3-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 24-250V ac	SPST SCR Solid-state 2-Wire		
SMA91ESR **SM91RSR** **SMA91ESRQD** **SM91RSRQD**	3 m (10')	2 m (6.5') 2 m (6.5') 3-Pin Mini QD 4-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 10-30V dc	Bipolar NPN/PNP		Effective Beam: 3.5 mm 
SMA91ESR **SM2A91RSR** **SMA91ESRQD** **SM2A91RSRQD**		2 m (6.5') 2 m (6.5') 3-Pin Mini QD 3-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 24-250V ac	SPST SCR Solid-state 2-Wire		



Visible red, 650 nm
Non-Polarized

Polarized

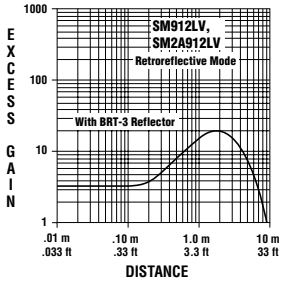
NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

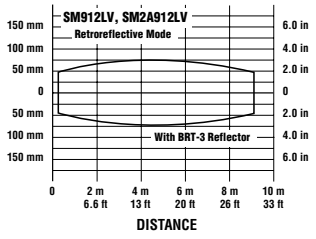


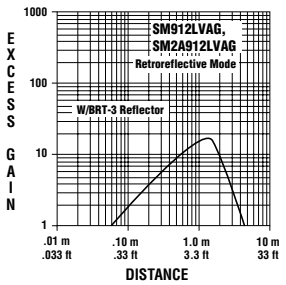
Non-Polarized, Polarized

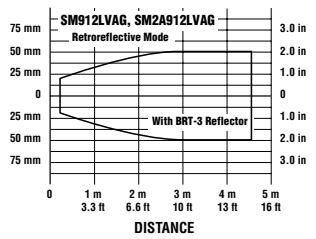
912 Series Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
SM912LV **SM912LVQD**	0.15 - 9 m (6" - 30')	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		
SM2A912LV **SM2A912LVQD**		2 m (6.5') 3-Pin Mini QD	24-250V ac	SPST SCR Solid-state 2-Wire		
Polarized*						
SM912LVAG **SM912LVAGQD**	0.3 - 4.5 m (1 - 15')	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		
SM2A912LVAG **SM2A912LVAGQD**		2 m (6.5') 3-Pin Mini QD	24-250V ac	SPST SCR Solid-state 2-Wire		







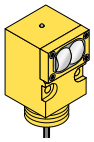


*Use polarized models when shiny objects will be sensed

For VALU-BEAM 912 Series Sensors:

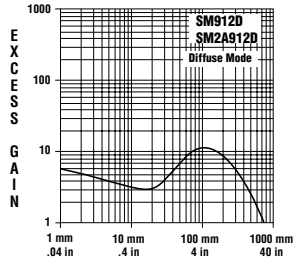
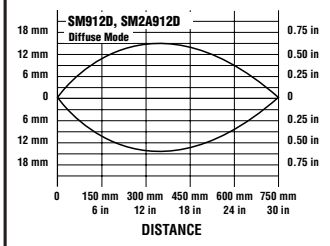
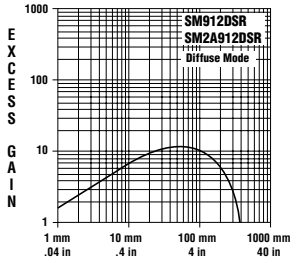
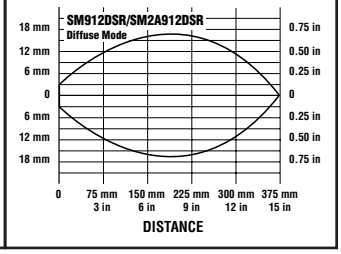
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SM912LV W/30**)

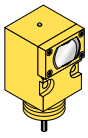
ii) A model with a QD connector requires an accessory mating cable. See pages 368 and the Accessories section for more information.



Infrared, 880 nm

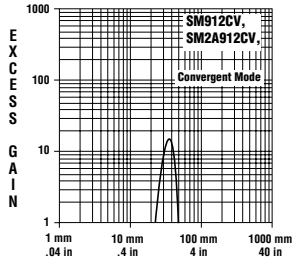
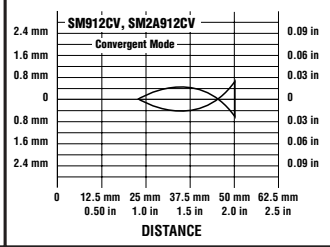
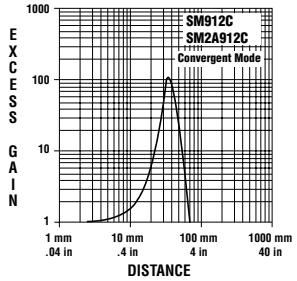
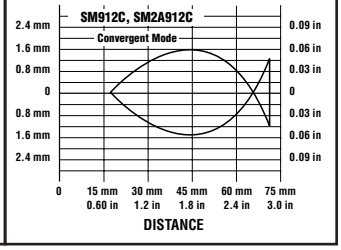
912 Series Diffuse Mode

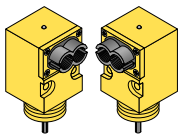
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SM912D **SM912DQD**	760 mm (30")	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		
SM2A912D **SM2A912DQD**		2 m (6.5') 3-Pin Mini QD	24-250V ac	SPST SCR Solid-state 2-Wire		
SM912DSR **SM912DSRQD**	380 mm (15")	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		
SM2A912DSR **SM2A912DSRQD**		2 m (6.5') 3-Pin Mini QD	24-250V ac	SPST SCR Solid-state 2-Wire		



See Sensing Beam Information Below

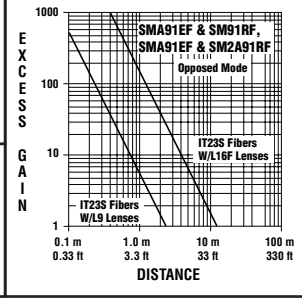
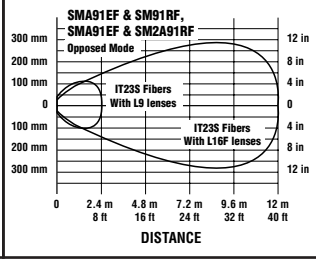
912 Series Convergent Mode

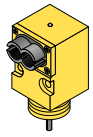
Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Visible Red 650 nm						
SM912CV **SM912CVQD**	38 mm (1.5") Spot Size at Focus: 1.5 mm (0.06")	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		
SM2A912CV **SM2A912CVQD**		2 m (6.5') 3-Pin Mini QD	24-250V ac	SPST SCR Solid-state 2-Wire		
Infrared 880 nm						
SM912C **SM912CQD**	38 mm (1.5")	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		
SM2A912C **SM2A912CQD**		2 m (6.5') 3-Pin Mini QD	24-250V ac	SPST SCR Solid-state 2-Wire		



Infrared 880 nm

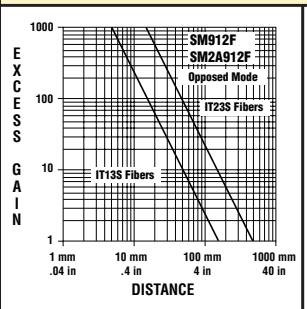
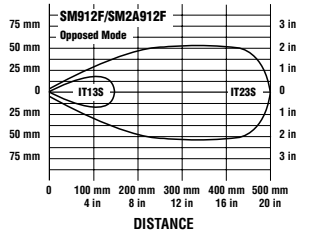
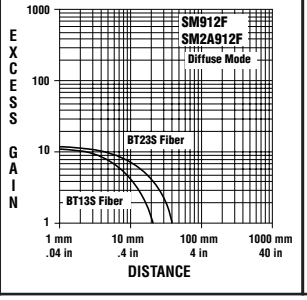
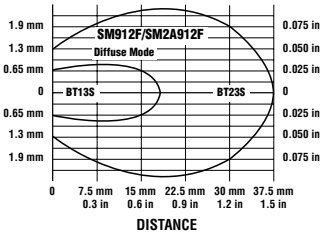
912 Series Glass Fiber Optic Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMA91EF **SM91RF** **SMA91EFQD** **SM91RFQD**	Range varies with fiber used	2 m (6.5') 2 m (6.5') 3-Pin Mini QD 4-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 10-30V dc	Bipolar NPN/PNP		
SMA91EF **SM2A91RF** **SMA91EFQD** **SM2A91RFQD**		2 m (6.5') 2 m (6.5') 3-Pin Mini QD 3-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 24-250V ac	SPST SCR Solid-state 2-Wire		



Infrared 880 nm

912 Series Glass Fiber Optic Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain Diffuse mode performance based on 90% reflectance white test card	Beam Pattern Diffuse mode performance based on 90% reflectance white test card
SM912F **SM912FQD**	Range varies with fiber optics used.	2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		
SM2A912F **SM2A912FQD**		2 m (6.5') 3-Pin QD	24-250V ac	SPST SCR Solid-state 2-Wire		

For VALU-BEAM 912 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SM912D W/30**)

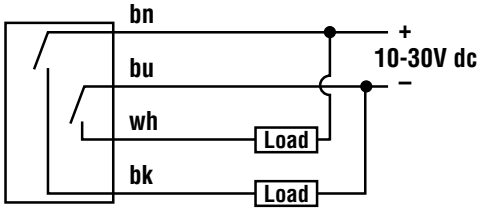
ii) A model with a QD connector requires an accessory mating cable. See pages 368 and the Accessories section for more information.

912 Series DC Specifications

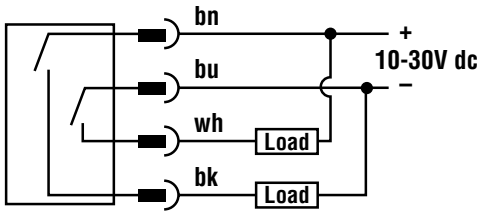
Supply Voltage and Current	10 to 30V dc at 20 mA maximum, exclusive of load (except for SMA91E, ESR and EF emitters, which operate from 10 to 250V ac or dc, 10 mA max.)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	250 mA continuous, each output **Off-state leakage** current less than 10 microamps **Output saturation voltage** (PNP output) less than 1 volt at 10 mA and less than 2 volts at 250 mA **Output saturation voltage** (NPN output) less than 200 millivolts at 10mA and less than 1 volt at 250 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Output Response Time	4 milliseconds ON/OFF (except receiver-only units which are 8 milliseconds ON and 4 milliseconds OFF); independent of signal strength (NOTE: 100 millisecond delay on power-up; outputs non-conducting during this time)
Repeatability	**Opposed and Glass Fiber Optic Emitter-Receiver pairs:** 1.0 millisecond; **Retro, Diffuse, Convergent and Glass Fiber Optic:** 1.3 milliseconds
Adjustments	LIGHT/DARK OPERATE select switch and SENSITIVITY control potentiometer, both located at rear of sensor
Indicators	Exclusive, patented Alignment Indicating Device (AID™, US patent #4356393) lights a top mounted red LED indicator whenever the sensor sees a “light” condition, with a superimposed pulse rate proportional to the light signal strength (the stronger the signal, the faster the pulse rate). Models SMA91E & SM91ESR emitter have a visible-red “tracer beam” which indicates “power on” and enables easy “line-of-sight” alignment.
Construction	Reinforced thermoplastic polyester housing, totally encapsulated, molded acrylic lenses and stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12 and 13; IEC IP66
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables or 4-pin mini-style quick-disconnect (QD) fitting available. Note: Opposed mode emitters use 3-pin mini-style QD fitting. See page 368 and the Accessories section.
Operating Conditions	**Temperature:** -20° to +70° C (-4° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	

912 Series DC Hookup Diagrams

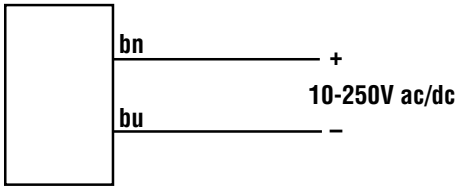
DC Sensors with Attached Cable



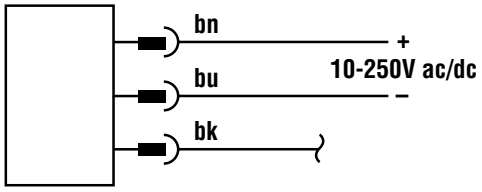
DC Sensors with Quick-Disconnect (4-Pin Mini-Style)



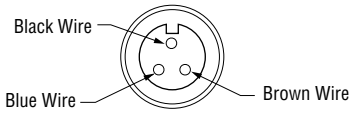
Emitters with Attached Cable



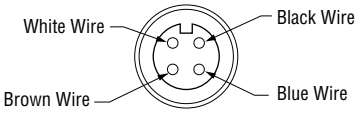
Emitters with Quick-Disconnect (3-Pin Mini-Style)



3-Pin Mini-Style Pin-out
(Cable Connector Shown)



4-Pin Mini-Style Pin-out
(Cable Connector Shown)



Quick-Disconnect (QD) Option

DC 912 Series VALU-BEAM sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 4-pin mini-style QD cable fitting. Opposed mode emitters use 3-pin mini-style QD cable fitting.

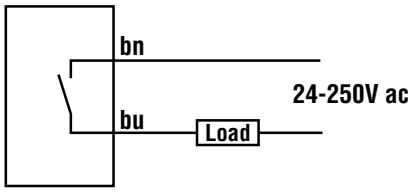
DC QD sensors are identified by the letters “QD” in their model number suffix. Mating cable for QD 912 Series sensors is model MBCC-412. Mating cable for opposed mode emitters is model MBCC-312. Cables are supplied in a standard length of 4 m (12'). For more information on QD cables, see page 368 and the Accessories section.

912 Series AC Specifications

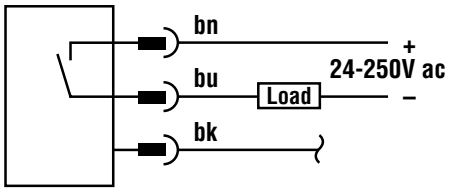
Supply Voltage and Current	24 to 250V ac (50/60 Hz), except for SMA91E, ESR and EF emitters, which operate from 10 to 250V ac or dc
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	SPST SCR solid-state relay with either normally closed or normally open contact (light/dark operate selectable); 2-wire hookup
Output Rating	Minimum load current 10 mA, max. steady-state load capability 750 mA to 50°C ambient (122°F), 500 mA to 70°C ambient (158°F) **Inrush capability** 4 amps for 1 sec. (non-repetitive) **Off-state leakage** current less than 1.7 mA rms **On-state voltage** drop ≤5 volts rms at 750 mA load, ≤10 volts rms at 15 mA load
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	8 milliseconds ON and OFF (except receiver-only units, which are 8 milliseconds 0N and 4 milliseconds OFF; independent of signal strength OFF time does not include load response of up to ½ ac cycle (8.3 milliseconds) Response time specification of the load should be considered when important (NOTE: 300 millisecond delay on power-up; outputs are non-conducting during this time)
Repeatability	**Opposed and Glass Fiber Optic Emitter-Receiver pairs:** 1.0 millisecond; **Retro, Diffuse, Convergent and Glass Fiber Optic:** 2.6 milliseconds
Adjustments	LIGHT/DARK OPERATE select switch and SENSITIVITY control potentiometer, both located at rear of sensor
Indicators	Top-mounted red LED indicator lights when output is conducting. Models SMA91E & SM91ESR emitter have a visible-red “tracer beam” which indicates “power on” and enables easy “line-of-sight” alignment.
Construction	Reinforced thermoplastic polyester housing, totally encapsulated, molded acrylic lenses and stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12 and 13; IEC IP66
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables or 3-pin mini-style quick-disconnect (QD) fitting available. See page 368 and the Accessories section.
Operating Conditions	**Temperature:** -20° to +70° C (-4° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	i) 912 Series ac sensors may be destroyed from overload conditions ii) Use on low voltage requires careful analysis of the load to determine if the leakage current or on-state voltage of the sensor will interfere with proper operation of the load iii) The false-pulse protection feature may cause momentary drop-out of the load when the sensor is wired in series or parallel with mechanical switch contacts
Certifications	

912 Series AC Hookup Diagrams

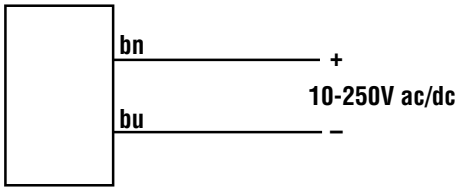
AC Sensors with Attached Cable



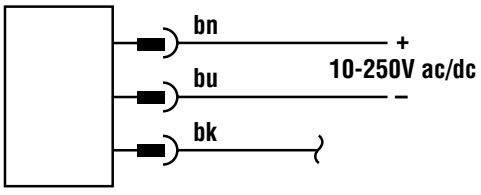
AC Sensors with Quick-Disconnect (3-Pin Mini-Style)



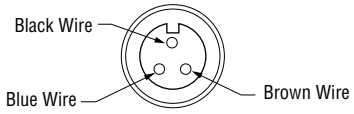
Emitters with Attached Cable



Emitters with Quick-Disconnect (3-Pin Mini-Style)



Mini-Style Pin-out
(Cable Connector Shown)



Quick-Disconnect (QD) Option

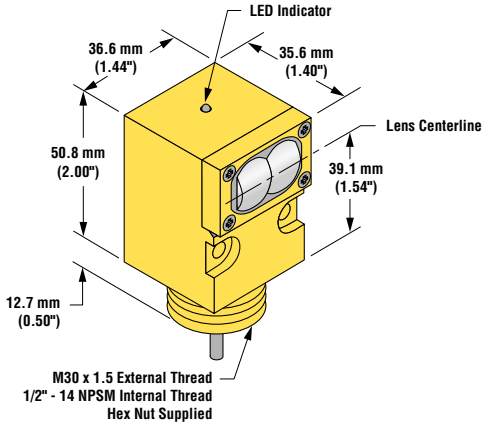
AC 912 Series VALU-BEAM sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 3-pin mini-style QD cable fitting.

AC QD sensors are identified by the letters “QD” in their model number suffix. Mating cables for QD 912 Series sensors are model MBCC-312. Cables are supplied in a standard length of 4 m (12'). For more information on QD cables, see page 368 and the Accessories section.

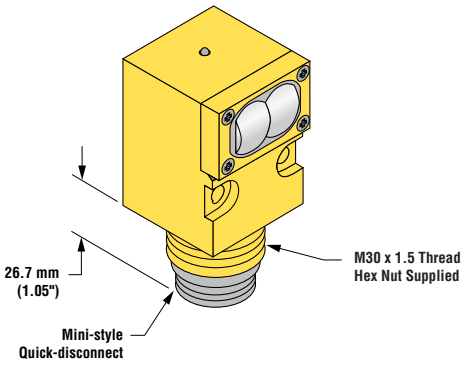
912 Series Dimensions

912 Series Opposed, Retro, and Diffuse Sensing Modes (model suffix E, ESR, R, RSR, LV, D & DSR)

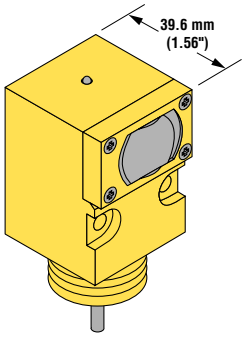
912 Series Sensor with Attached Cable



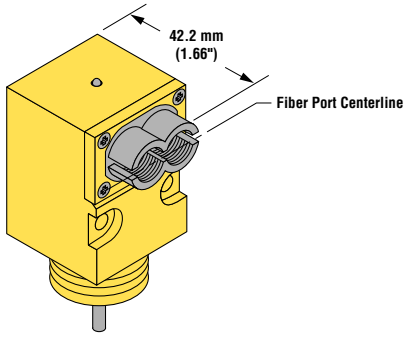
912 Series Sensor with Quick-Disconnect



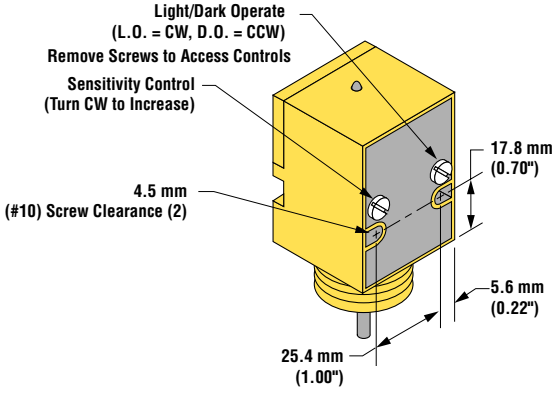
912 Series Sensor - Convergent Sensing Mode (model suffix LVAG, C & CV)



912 Series Sensor - Glass Fiber Optic (model suffix F, EF & RF)



912 Series Sensor - Rear View



NOTES:

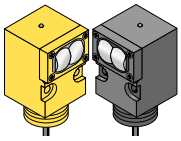
VALU-BEAM 915 Series Sensors

with Electromechanical Relay Output

VALU-BEAM 915 Series quick-disconnect (left) and cabled (right) versions shown

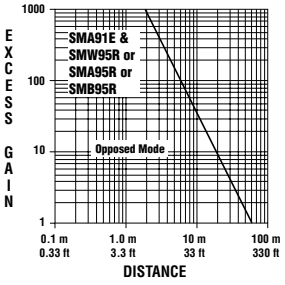
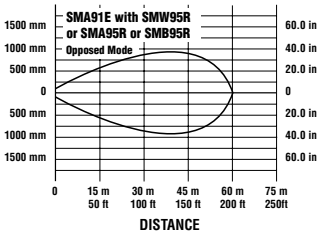
- Models available for either 12 to 28V ac/dc, 90 to 130V ac, or 210 to 250V ac
- SPDT electromechanical relay output is rated for up to 5 amps switching capacity
- Rear panel sensitivity adjustment; top-mounted alignment indicator
- Choose models with integral 2 m (6.5') cable or mini-style QD (quick-disconnect) connector; 9 m (30') cables are also available

915 Series Sensing Mode Options

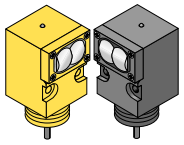


Infrared, 880 nm

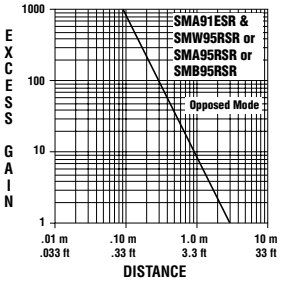
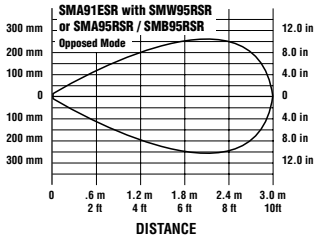
915 Series Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMA91E **SMW95R** **SMA91EQD** **SMW95RQD**	60 m (200')	2 m (6.5') 2 m (6.5') 3-Pin Mini QD 5-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 12-28V ac/dc	SPDT E/m Relay		Effective Beam: 13 mm 
SMA91E **SMA95R** **SMA91EQD** **SMA95RQD**		2 m (6.5') 2 m (6.5') 3-Pin Mini QD 5-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 90-130V ac			
SMA91E **SMB95R** **SMA91EQD** **SMB95RQD**		2 m (6.5') 2 m (6.5') 3-Pin Mini QD 5-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 210-250V ac			

Infrared 880 nm



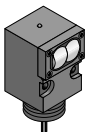
915 Series Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMA91ESR **SMW95RSR** **SMA91ESRQD** **SMW95RSRQD**	3 m (10')	2 m (6.5') 2 m (6.5') 3-Pin Mini QD 5-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 12-28V dc	SPDT E/m Relay		Effective Beam: 3.5 mm 
SMA91ESR **SMA95RSR** **SMA91ESRQD** **SMA95RSRQD**		2 m (6.5') 2 m (6.5') 3-Pin Mini QD 5-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 90-130V ac			
SMA91ESR **SMB95RSR** **SMA91ESRQD** **SMB95RSRQD**		2 m (6.5') 2 m (6.5') 3-Pin Mini QD 5-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 210-250V ac			

For VALU-BEAM 915 Series Sensors:

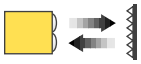
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SMA91E W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 368 and the Accessories section for more information.



Non-Polarized, Polarized

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

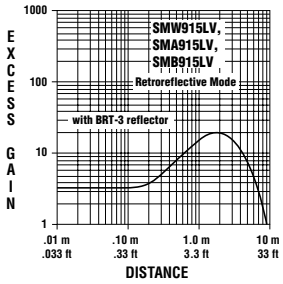
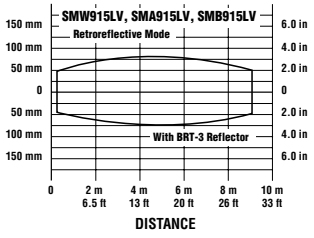
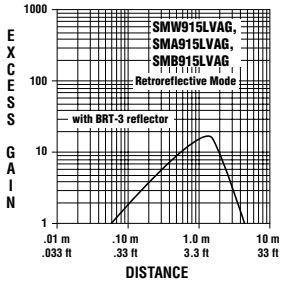
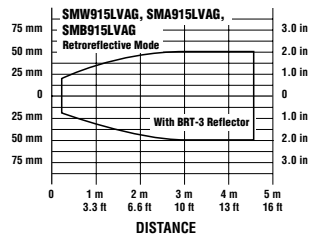


Non-Polarized

Visible red, 650 nm

Polarized

915 Series Retroreflective Mode

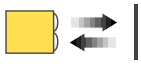
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
SMW915LV **SMW915LVQD**	0.15 - 9 m (6" - 30')	2 m (6.5') 5-Pin Mini QD	12-28V ac/dc	SPDT E/m Relay		
SMA915LV **SMA915LVQD**		2 m (6.5') 5-Pin Mini QD	90-130V ac			
SMB915LV **SMB915LVQD**		2 m (6.5') 5-Pin Mini QD	210-250V ac			
Polarized*						
SMW915LVAG **SMW915LVAGQD**	0.3 - 4.5 m (1 - 15')	2 m (6.5') 5-Pin Mini QD	12-28V ac/dc	SPDT E/m Relay		
SMA915LVAG **SMA915LVAGQD**		2 m (6.5') 5-Pin Mini QD	90-130V ac			
SMB915LVAG **SMB915LVAGQD**		2 m (6.5') 5-Pin Mini QD	210-250V ac			

*Use polarized models when shiny objects will be sensed

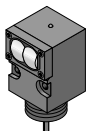
For VALU-BEAM 915 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SMW915D W/30**)

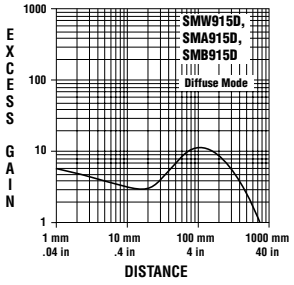
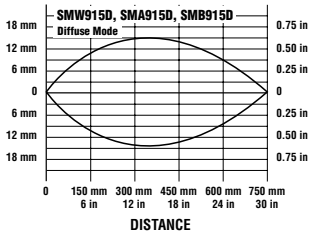
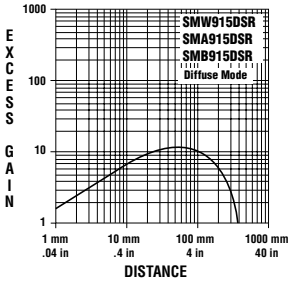
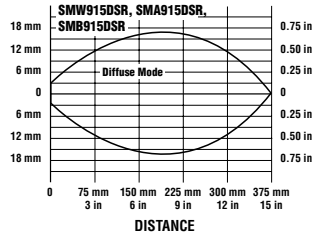
ii) A model with a QD connector requires an accessory mating cable. See pages 368 and the Accessories section for more information.

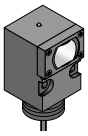


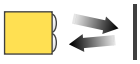
Infrared 880 nm



915 Series Diffuse Mode

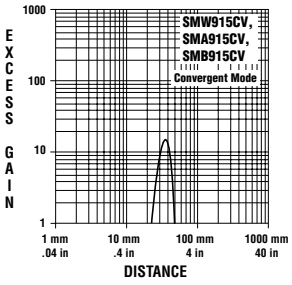
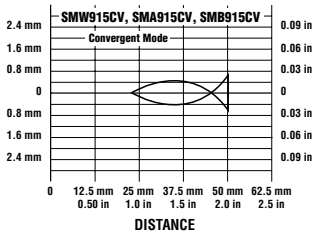
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SMW915D **SMW915DQD**	760 mm (30")	2 m (6.5') 5-Pin Mini QD	12-28V ac/dc	SPDT E/m Relay		
SMA915D **SMA915DQD**		2 m (6.5') 5-Pin Mini QD	90-130V ac			
SMB915D **SMB915DQD**		2 m (6.5') 5-Pin Mini QD	210-250V ac			
SMW915DSR **SMW915DSRQD**	380 mm (15")	2 m (6.5') 5-Pin Mini QD	12-28V ac/dc	SPDT E/m Relay		
SMA915DSR **SMA915DSRQD**		2 m (6.5') 5-Pin Mini QD	90-130V ac			
SMB915DSR **SMB915DSRQD**		2 m (6.5') 5-Pin Mini QD	210-250V ac			

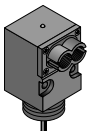




Visible red 650 nm

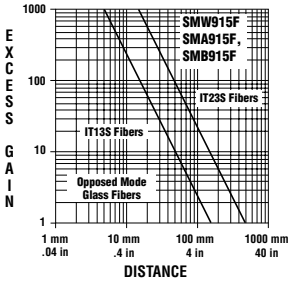
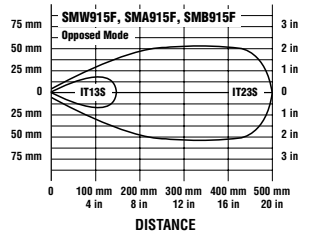
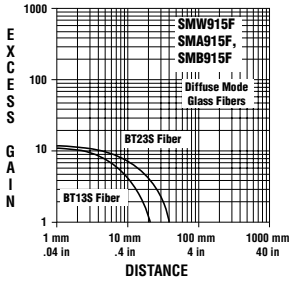
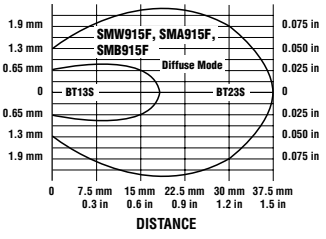
915 Series Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SMW915CV **SMW915CVQD**	38 mm (1.5") Spot Size at Focus: 1.5 mm (0.06")	2 m (6.5') 5-Pin Mini QD	12-28V ac/dc	SPDT E/m Relay		
SMA915CV **SMA915CVQD**		2 m (6.5') 5-Pin Mini QD	90-130V ac			
SMB915CV **SMB915CVQD**		2 m (6.5') 5-Pin Mini QD	210-250V ac			

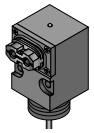


Infrared, 880 nm

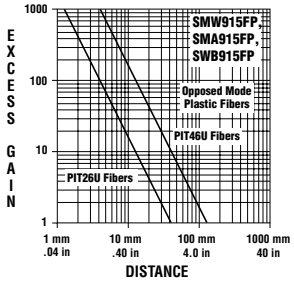
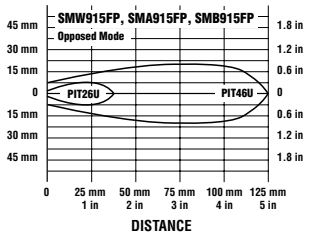
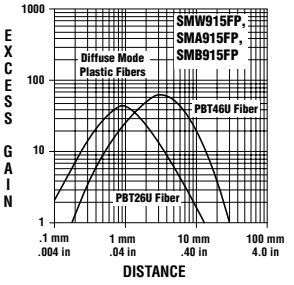
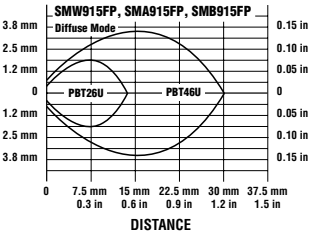
915 Series Glass Fiber Optic Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
SMW915F **SMW915FQD**	Range varies by sensing mode and fiber used.	2 m (6.5') 5-Pin Mini QD	12-28V ac/dc	SPDT E/m Relay		
SMA915F **SMA915FQD**		2 m (6.5') 5-Pin Mini QD	90-130V ac			
SMB915F **SMB915FQD**		2 m (6.5') 5-Pin Mini QD	210-250V ac			

Visible red, 650 nm



915 Series Plastic Fiber Optic Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
SMW915FP **SMW915FPQD**	Range varies by sensing mode and fiber used.	2 m (6.5') 5-Pin Mini QD	12-28V ac/dc	SPDT E/m Relay		
SMA915FP **SMA915FPQD**		2 m (6.5') 5-Pin Mini QD	90-130V ac			
SMB915FP **SMB915FPQD**		2 m (6.5') 5-Pin Mini QD	210-250V ac			

For VALU-BEAM 915 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SMW915FP W/30**)

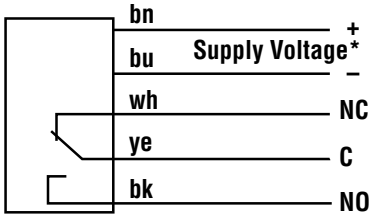
ii) A model with a QD connector requires an accessory mating cable. See pages 368 and the Accessories section for more information.

915 Series Specifications

Supply Voltage and Current	**SMW915 Series:** 12 to 28V ac or dc at 50 mA maximum, exclusive of load **SMA915 Series:** 90 to 130V ac (50-60 Hz) at 20 mA maximum, exclusive of load **SMB915 Series:** 210 to 250V ac (50-60 Hz) at 20 mA maximum, exclusive of load Exceptions: SMA91E and ESR emitters, which operate from 10-250V ac (50-60 Hz) or dc (10 mA max.)
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	One internal “form C” (single-pole double-throw) electromechanical relay
Output Rating	Max. switching power (resistive load) = 150 W, 600 VA Max. switching voltage (resistive load) = 250V ac or 30 V dc (120V ac max. per UL & CSA) Max. switching current (resistive load) = 5A Min.. voltage and current = 1 amp at 5V dc, 0.1 amp at 24V dc Peak switching voltage = 750V ac (transient suppression recommended) Mechanical life of relay = 10,000,000 operations
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	20 milliseconds ON and OFF; independent of signal strength (NOTE: 100 millisecond relay on power-up; relay de-energized during this time)
Adjustments	SENSITIVITY control on rear of sensor allows precise gain setting (turn clockwise to increase gain)
Indicators	Top-mounted red LED indicator lights whenever the sensor sees “light” condition. Models SMA91E and SMA91ESR emitters have visible-red “tracer beam” which indicates “power on” and enables easy “line-of-sight” alignment.
Construction	Reinforced black thermoplastic polyester housing, totally encapsulated, molded acrylic lenses and stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12 and 13; IEC IP66
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cable or 5-pin mini-style quick-disconnect (QD) fitting available. See page 368 and Accessories section.
Operating Conditions	**Temperature:** -40° to +50° C (-40° to +122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Install transient suppressor (MOV) across any output contact which switches an inductive load
Certifications	

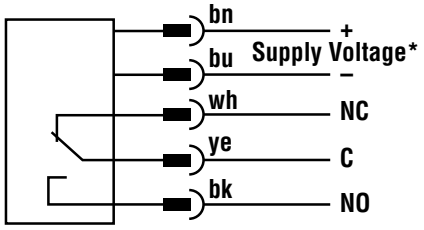
915 Series Hookup Diagrams

Sensors with Attached Cable



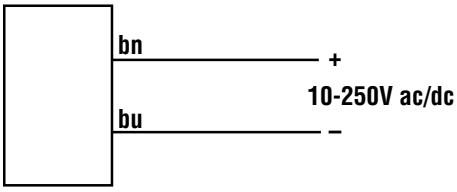
*see Specifications

Sensors with Quick-Disconnect (5-Pin Mini-Style)

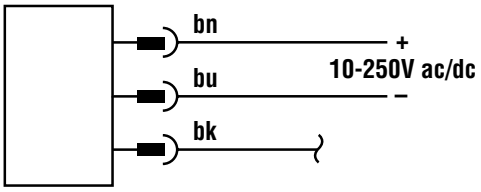


*see Specifications

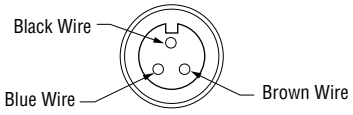
Emitters with Attached Cable



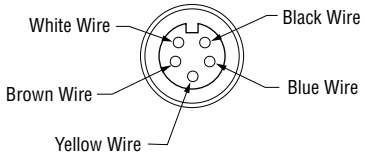
Emitters with Quick-Disconnect (3-Pin Mini-Style)



3-Pin Mini-Style Pin-out (Cable Connector Shown)



5-Pin Mini-Style Pin-out (Cable Connector Shown)



Quick-Disconnect (QD) Option

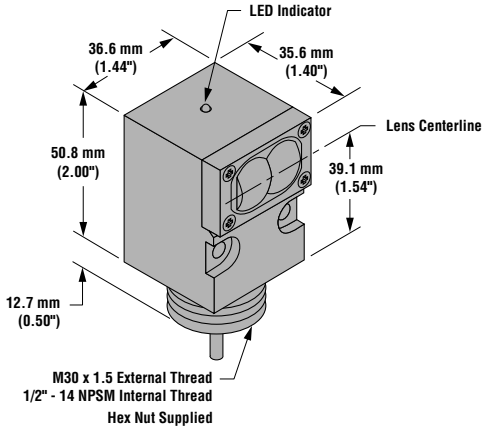
915 Series VALU-BEAM sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 5-pin mini-style QD cable fitting. Opposed mode emitters use 3-pin mini-style QD cable fitting.

QD sensors are identified by the letters “QD” in their model number suffix. Mating cables for QD 915 Series sensors are model MBCC-512. Cables are supplied in a standard length of 4 m (12'). For more information on QD cables, see page 368 and the Accessories section.

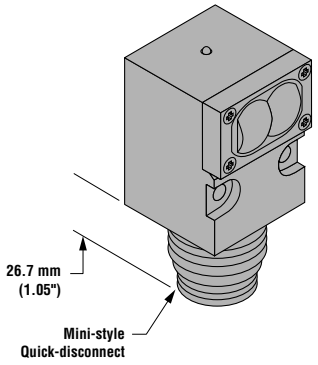
915 Series Dimensions

915 Series Opposed, Retro, and Diffuse Sensing Modes (model suffix E, ESR, R, RSR, LV, D & DSR)

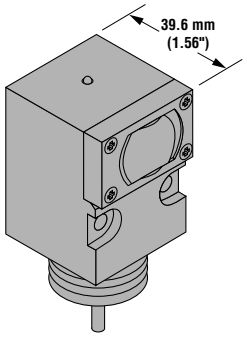
915 Series Sensor with Attached Cable



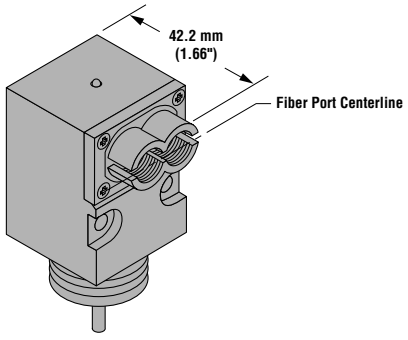
915 Series Sensor with Quick-Disconnect



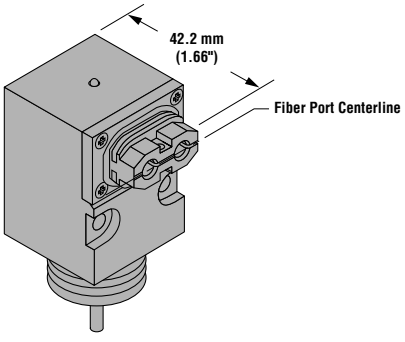
915 Series Sensor - Convergent Sensing Mode (model suffix LVAG & CV)



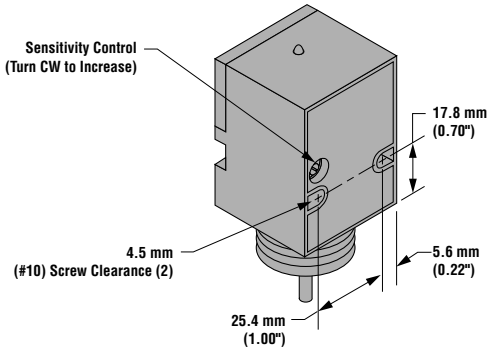
915 Series Sensor - Glass Fiber Optic (model suffix F)



915 Series Sensor - Plastic Fiber Optic (model suffix FP)



915 Series Sensor - Rear View



NOTES:

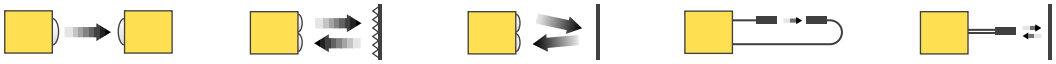
VALU-BEAM 990 Series Sensors

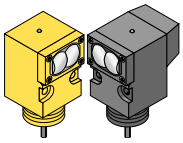
With Built-In Totalizing Counter

VALU-BEAM 990 Series quick-disconnect and cabled models shown

- Each sensor is an economical, one-piece photoelectric counting system
- Simple, 2-wire hookup to universal voltage: 12 to 115V dc or 10 to 250V ac
- Six-digit totalizer is reset upon power-up, or by touching the top of the sensor with a permanent magnet
- Models are available with memory backup to "hold" count for up to 100 hours with power removed (order model suffix "MB")
- Specially-designed infrared retroreflective version is available for counting people passing through entryways

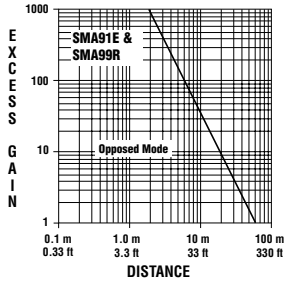
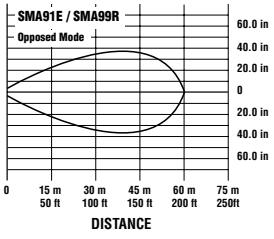
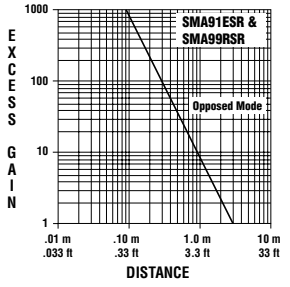
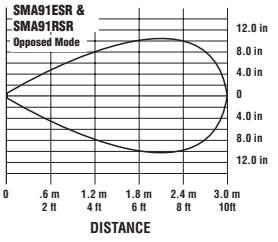
990 Series Sensing Mode Options

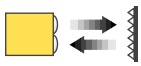




Infrared, 880 nm

990 Series Opposed Mode Emitter (E) and Receiver (R)

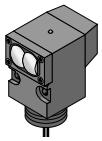
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMA91E **SMA99R** **SMA91EQD** **SMA99RQD**	60 m (200')	2 m (6.5') 2 m (6.5') 3-Pin Mini QD 3-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 10-250V ac or 12-115V dc	Built-in 6-digit totalizing counter		Effective Beam: 12.7 mm 
SMA91ESR **SMA99RSR** **SMA91ESRQD** **SMA99RSRQD**	3 m (10')	2 m (6.5') 2 m (6.5') 3-Pin Mini QD 3-Pin Mini QD	Emitter: 10-250V ac/dc Receiver: 10-250V ac or 12-115V dc	Built-in 6-digit totalizing counter		Effective Beam: 3.5 mm 



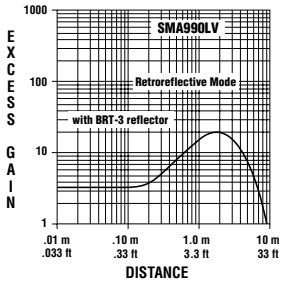
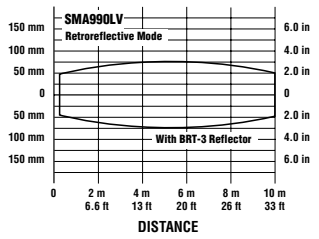
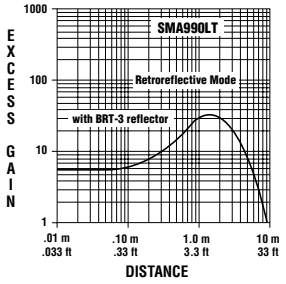
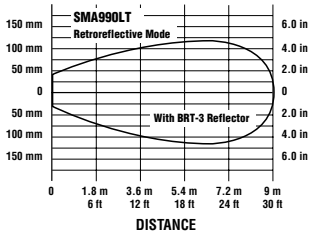
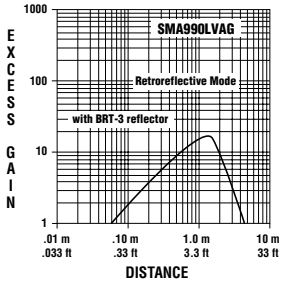
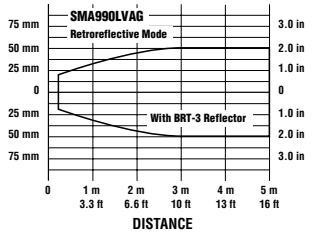
Visible red 650 nm and Infrared 940 nm
Non-Polarized

Polarized

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3-inch diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



990 Series Retroreflective Mode

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized (Visible red, 650 nm)						
SMA990LV **SMA990LVQD**	0.15 - 9 m (6" - 30')	2 m (6.5') 3-Pin Mini QD	10-250V ac or 12-115V dc	Built-in 6-digit totalizing counter		
Non-Polarized (Infrared, 940 nm)*						
SMA990LT **SMA990LTQD**	9 m (30')	2 m (6.5') 3-Pin Mini QD	10-250V ac or 12-115V dc	Built-in 6-digit totalizing counter		
Polarized (Visible red, 650 nm)†						
SMA990LVAG **SMA990LVAGQD**	0.3 - 4.5 m (1 - 15')	2 m (6.5') 3-Pin Mini QD	10-250V ac or 12-115V dc	Built-in 6-digit totalizing counter		

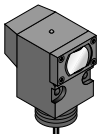
* Note: "LT" models include 0.1 second delays to minimize multiple counts in "people counting" applications.

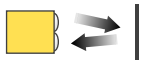
† Use polarized models when shiny objects will be counted.

For VALU-BEAM 990 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SMA990LV W/30**)

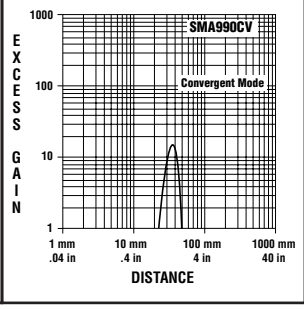
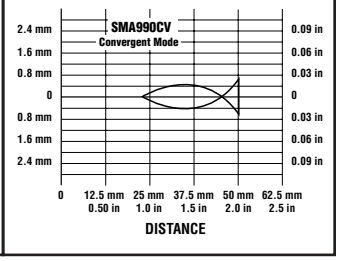
ii) A model with a QD connector requires an accessory mating cable. See pages 368 and the Accessories section for more information.

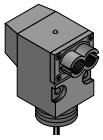




Visible red 650 nm

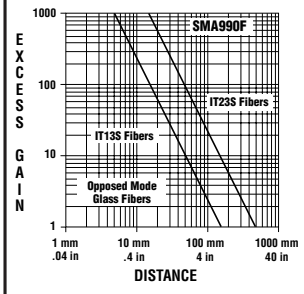
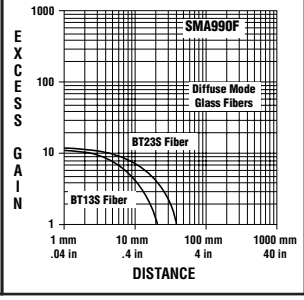
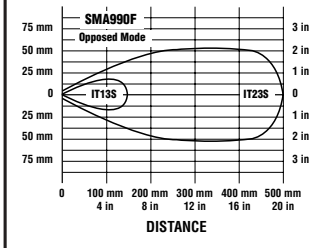
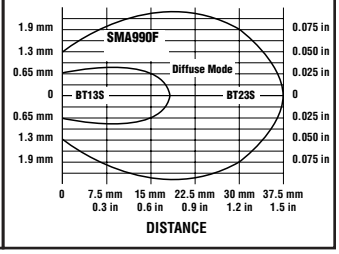
990 Series Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SMA990CV **SMA990CVQD**	38 mm (1.5") Spot Size at Focus: 1.5 mm (0.06")	2 m (6.5') 3-Pin Mini QD	10-250V ac or 12-115V dc	Built-in 6-digit totalizing counter		



Infrared, 880 nm

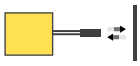
990 Series Glass Fiber Optic

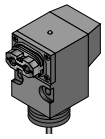
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
SMA990F **SMA990FQD**	Range varies by sensing mode and fiber optics used	2 m (6.5') 3-Pin Mini QD	10-250V ac or 12-115V dc	Built-in 6-digit totalizing counter	 	 

For VALU-BEAM 990 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SMA990CV W/30**)

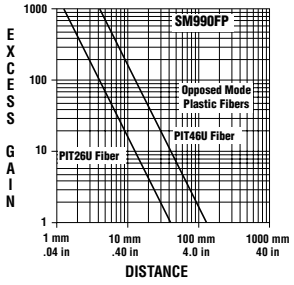
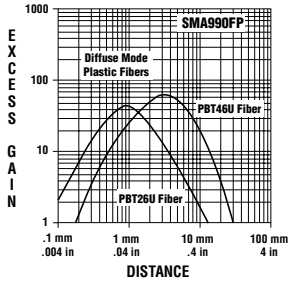
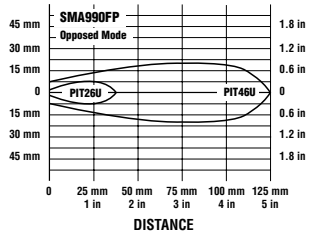
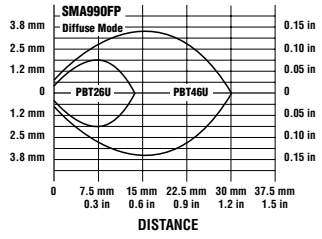
ii) A model with a QD connector requires an accessory mating cable. See pages 368 and the Accessories section for more information.





Visible red, 650 nm

990 Series Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
SMA990FP **SMA990FPQD**	Range varies by sensing mode and fiber optics used	2 m (6.5') 3-Pin Mini QD	10-250V ac or 12-115V dc	Built-in 6-digit totalizing counter	 	 

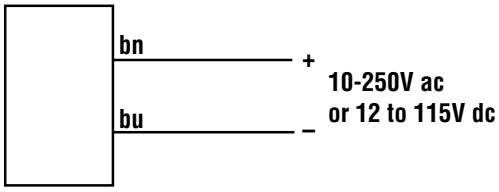
990 Series Specifications

Supply Voltage and Current	990 Series sensors wire directly to either 10 to 250V ac (50/60 Hz) or 12 to 115V dc at less than 20 milliamps
Supply Protection Circuitry	Protected against transient voltages
Sensor Response Time	15 milliseconds LIGHT; 15 milliseconds DARK (except model SMA990LT); independent of signal strength NOTE: 100 millisecond delay on power up (no counts are entered during this time)
Count Entry	Counts are entered on DARK-to-LIGHT transition
Count Reset	In standard models, counter is reset to zero automatically upon applying power to the sensor. All models may be reset by touching the housing on top of the sensor with permanent magnet (supplied with sensor)
Indicators	Top-mounted red LED indicator lights whenever the sensor sees “light” condition. Models SMA91E and SMA91ESR emitters have visible-red “tracer beam” which indicates “power on” and enables easy “line-of-sight” alignment.
Construction	Reinforced thermoplastic polyester housing, totally encapsulated, o-ring sealed lenses or fiber fittings, stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12 and 13; IEC IP66
Connections	PVC-jacketed 2-conductor 2 m (6.5') or 9 m (30') cables or 3-pin mini-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 368 and Accessories section.
Operating Conditions	**Temperature:** 0° to 50°C (32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Models with memory backup have no power-up delay. Some models with memory backup may increment 1 count upon reapplication of power
Certifications	

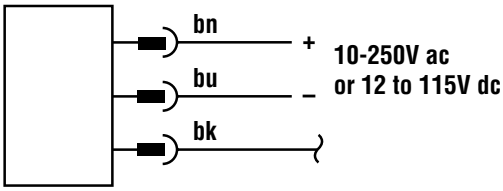
Note: 990 Series sensors with internal memory backup (MB) for maintaining “count memory” are available by special order by adding the suffix **“MB”** to the model number (eg.- **SMA990LVMB**).

990 Series Hookup Diagrams

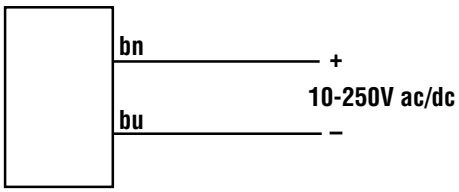
Sensors with Attached Cable



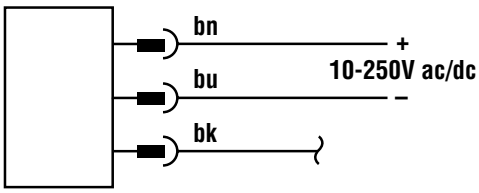
Sensors with Quick-Disconnect 3-Pin Mini-Style



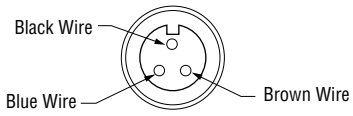
Emitters with Attached Cable



Emitters with Quick-Disconnect 3-Pin Mini-Style



3-Pin Mini-Style Pin-out
(Cable Connector Shown)



Quick-Disconnect (QD) Option

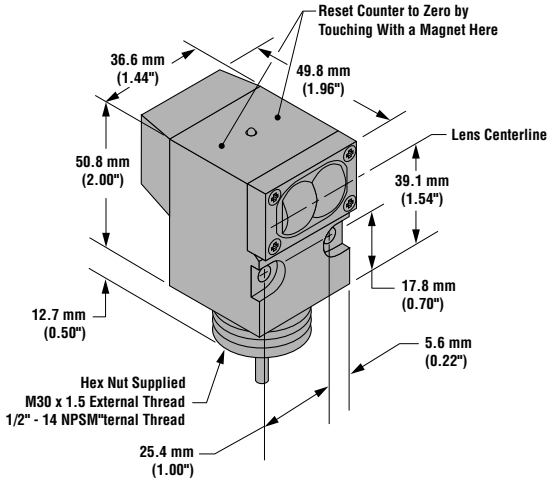
990 Series VALU-BEAM sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 3-pin mini-style QD cable fitting.

QD sensors are identified by the letters “QD” in their model number suffix. Mating cables for QD 990 Series sensors are model MBCC-312. Cables are supplied in a standard length of 4 m (12'). For more information on QD cables, see page 368 and the Accessories section.

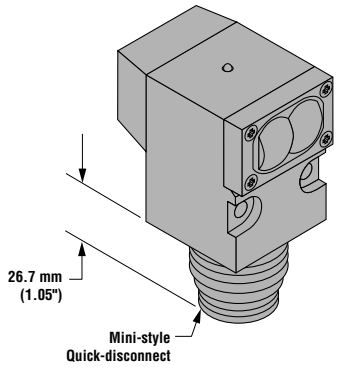
990 Series Dimensions

990 Series Opposed, Retro, and Diffuse Sensing Modes (model suffix E, ESR, R, RSR, LV & LT)

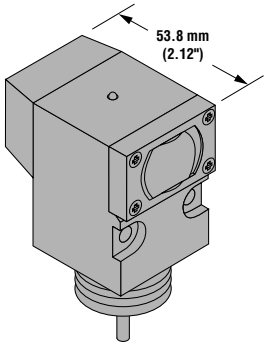
990 Series Sensor with Attached Cable



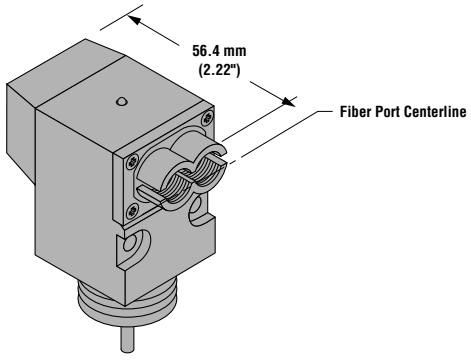
990 Series Sensor with Quick-Disconnect



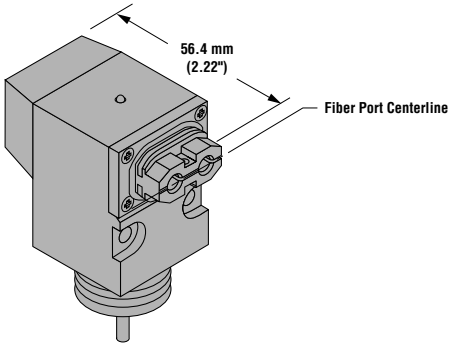
990 Series Sensor - Convergent Sensing Mode (model suffix LVAG & CV)



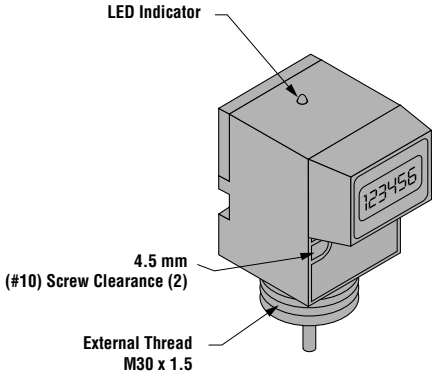
990 Series Sensor - Glass Fiber Optic (model suffix F)



990 Series Sensor - Plastic Fiber Optic (model suffix FP)

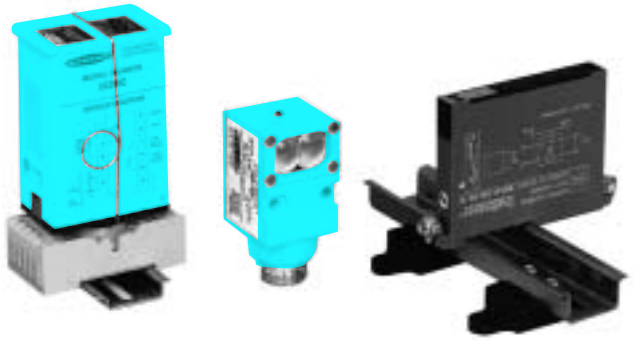


990 Series Sensor - Rear View



NOTES:

VALU-BEAM SMI912 Series Sensors

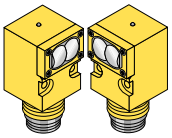


SMI912 Series sensor, with CI3RC2 current amplifier module (left) and intrinsic safety barrier (right)

- Intrinsically safe sensors with the performance of VALU-BEAM Sensors
- Use with approved intrinsic safety barriers and model CI3RC2 current trip point amplifier (see hookup diagram on page 361)
- Certified for use in all Classes, Groups and Divisions of hazardous locations as defined by Article 500 of the National Electrical Code when used with approved I.S. barriers
- All models have rear panel sensitivity control and light/dark operate switch, plus Banner's exclusive† Alignment Indicating Device system (AID™)
- 3-pin mini-style quick-disconnect (QD) connector is standard on all models; mating cables are ordered separately

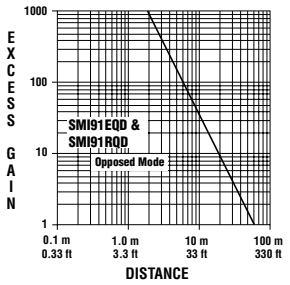
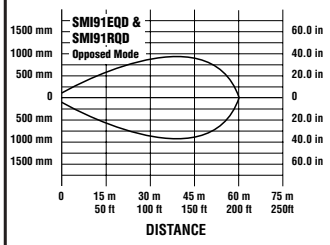
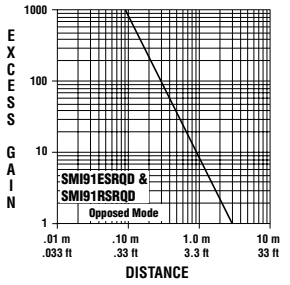
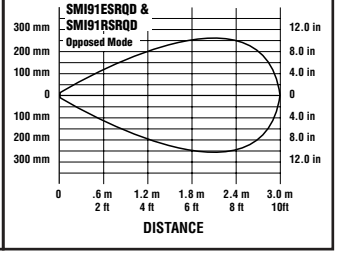
† U.S. Patent #4356393

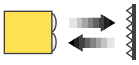
SMI912 Series Sensing Mode Options



Infrared, 880 nm

SMI912 Series Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMI91EQD **SMI91RQD**	60 m (200')	3-Pin Mini QD	10-30V dc	Receiver: NPN		Effective Beam: 13 mm 
SMI91ESRQD **SMI91RSRQD**	3 m (10')	3-Pin Mini QD	10-30V dc	Receiver: NPN		Effective Beam: 3.5 mm 

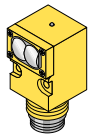


Visible red, 650 nm

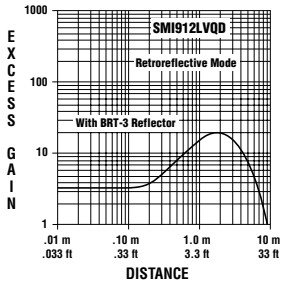
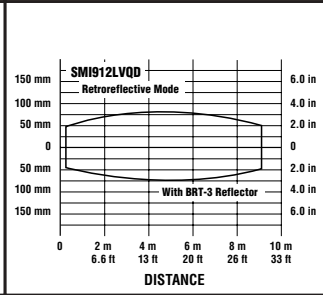
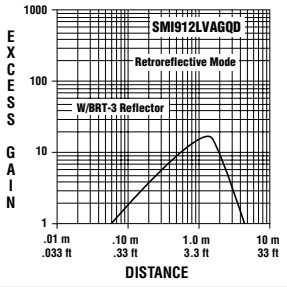
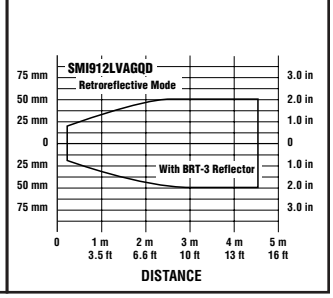
Non-Polarized

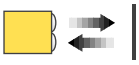
Polarized

NOTE: Use polarized model when shiny objects will be sensed. Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

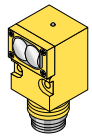


SMI912 Series Retroreflective Mode

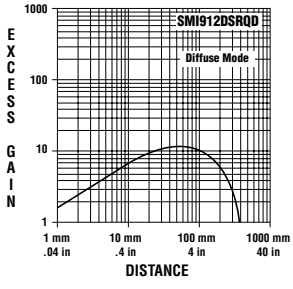
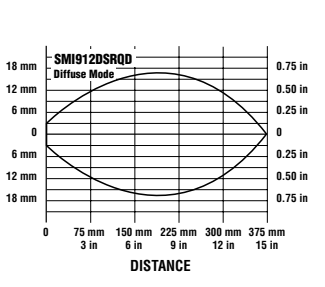
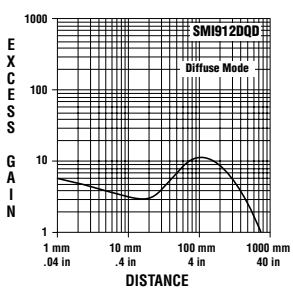
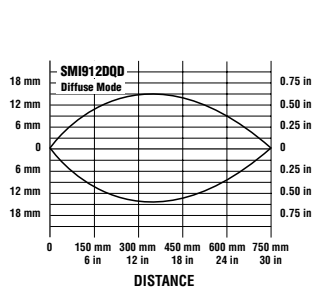
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
SMI912LVQD	0.15 - 9 m (6" - 30')	3-Pin Mini QD	10-30V dc	NPN		
Polarized						
SMI912LVAGQD	0.3 - 4.5 m (1 - 15')	3-Pin Mini QD	10-30V dc	NPN		

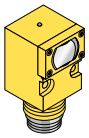


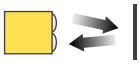
Infrared 880 nm



SMI912 Series Diffuse Mode

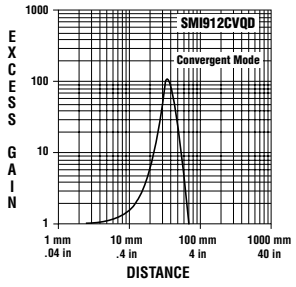
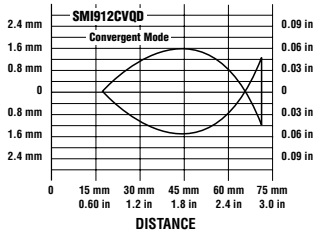
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SMI912DSRQD	390 mm (15")	3-Pin Mini QD	10-30V dc	NPN		
SMI912DQD	780 mm (30")	3-Pin Mini QD	10-30V dc	NPN		

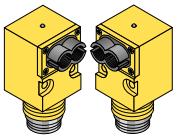




Visible red 650 nm

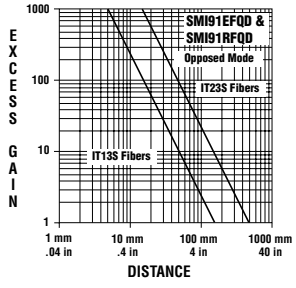
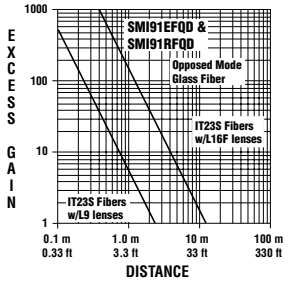
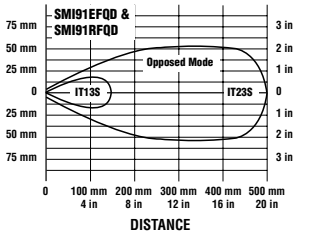
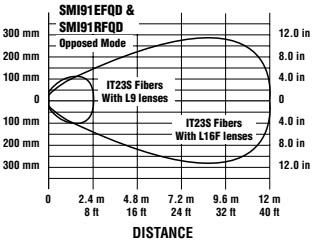
SMI912 Series Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
SMI912CVQD	38 mm (1.5") Spot Size at Focus: 1.5 mm (0.06"))	3-Pin Mini QD	10-30V dc	NPN		



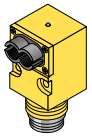
Infrared, 880 nm

SMI912 Series Glass Fiber Optic Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
SMI91EFQD **SMI91RFQD**	Range varies with fiber optics used	3-Pin Mini QD	10-30V dc	NPN	 	 

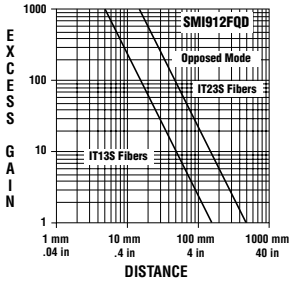
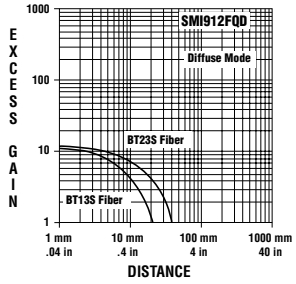
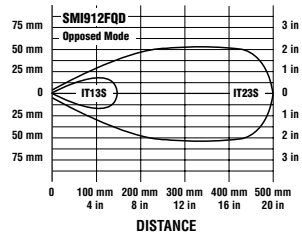
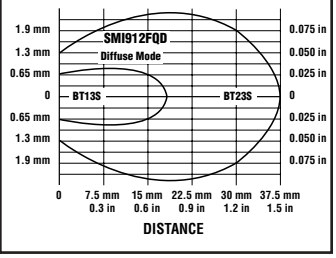
For VALU-BEAM SMI912 Series Sensors:

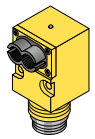
i) All models require a mating cable. See page 368 for more information.



Infrared, 880 nm

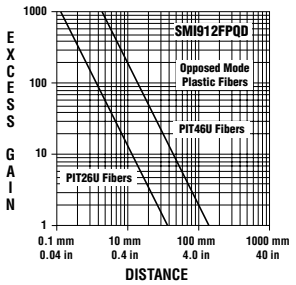
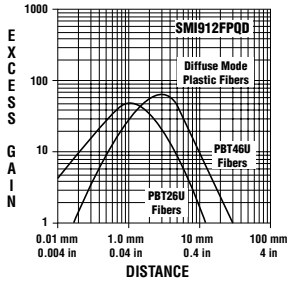
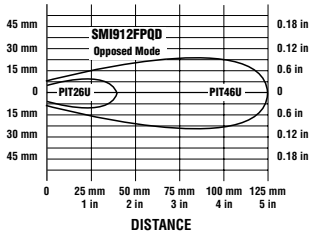
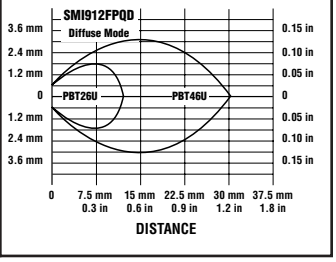
SMI912 Series Glass Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
SMI912FQD	Range varies by sensing mode and fiber optics used	3-Pin Mini QD	10-30V dc	NPN	 	 



Visible red, 650 nm

SMI912 Series Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
SMI912FPQD	Range varies by sensing mode and fiber optics used	3-Pin Mini QD	10-30V dc	NPN	 	 

SMI912 Series Specifications

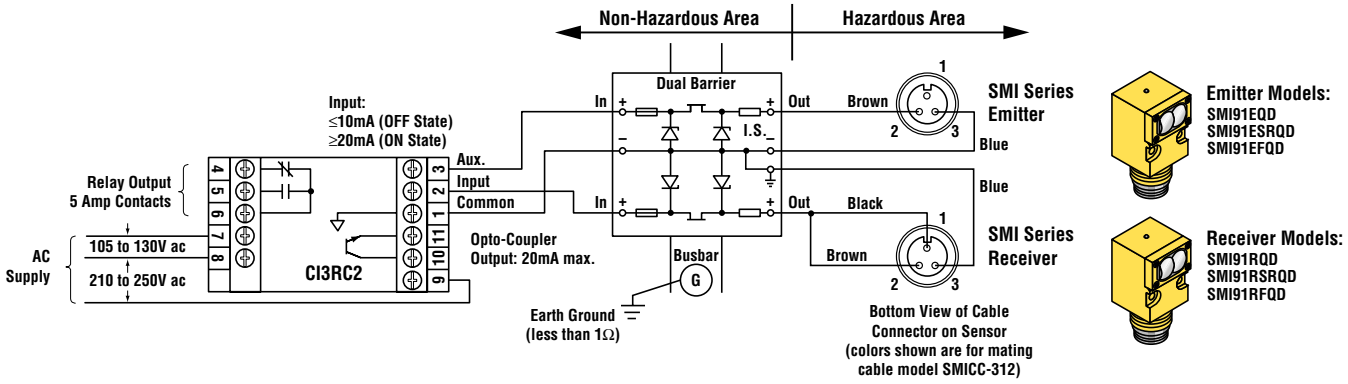
Supply Voltage and Current	10 to 30V dc for sensor, 25 mA maximum Division 1 use, with barriers, requires a minimum system supply voltage of 10V
Output Configuration	Current sinking NPN open collector transistor
Output Rating	3-wire hookup sinks 15 mA maximum, continuous 2-wire hookup sinks ≤10 mA (OFF-state) and ≥20 mA (ON state)
Output Protection Circuitry	Protected against false pulse on power-up and short circuit of output
Output Response Time	4 milliseconds ON and OFF, except for opposed mode receivers, which are 8 ms ON, 4 ms OFF; independent signal strength (NOTE: 100 millisecond delay on power-up: output is non-conducting during this time)
Repeatability	**Opposed:** 1.0 millisecond; **Retro, Diffuse, Convergent, Plastic and Glass Fiber Optic:** 1.3 milliseconds
Adjustments	LIGHT/DARK OPERATE select switch on rear of sensor Sensitivity control on rear of sensor allows precise gain setting (turn clockwise to increase gain)
Indicators	Exclusive, patented Alignment Indicating Device (AID™, US patent #4356393) lights at top mounted red LED indicator whenever the sensor sees a "light" condition, with a superimposed pulse rate proportional to the light signal strength (the stronger the signal, the faster the pulse rate).
Construction	Reinforced thermoplastic polyester housing, totally encapsulated, molded acrylic lenses, stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 12 and 13; IEC IP66
Connections	Supplied with 3-pin quick-disconnect (QD) fitting and requires the use of mating cable model SMICC-312. Cable is not supplied with sensors. See page 368 and Accessories section.
Operating Conditions	**Temperature:** -20° to +70°C (-4 to +158°F) **Relative relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE, CSA Exia ® NRTL/C, Ex KEMA, FM APPROVED

APPROVALS

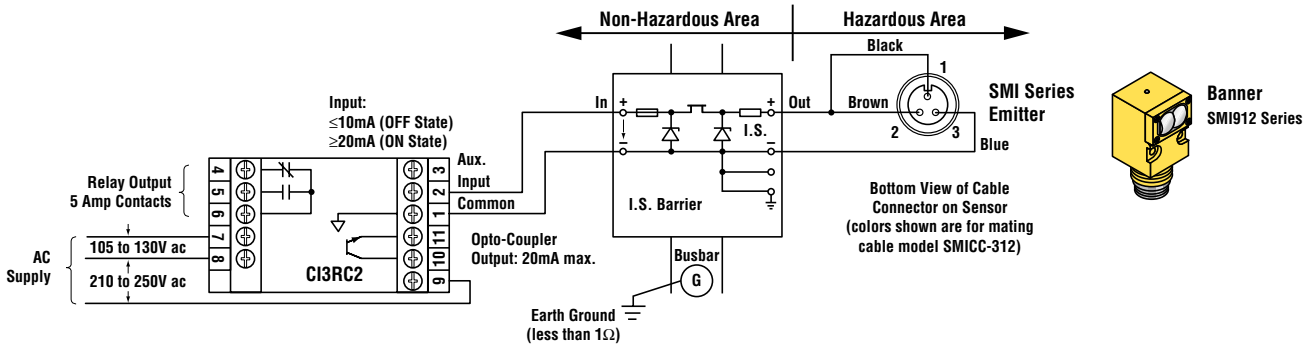
CSA:	#LR 41887	Instrinsically Safe, with Entity for: Class I, Groups A-D Class I, Div. 2, Groups A-D
FM:	#J.I. OR3HO.AX	Intrinsically Safe, with Entity for: Class I, II, III, Div. 1, Groups A-G Class I, II, III, Div. 2, Groups A-D and G
KEMA:	#Ex-96.D.0950	EEx ia IIC T6

SMI912 Series Hookup Diagrams

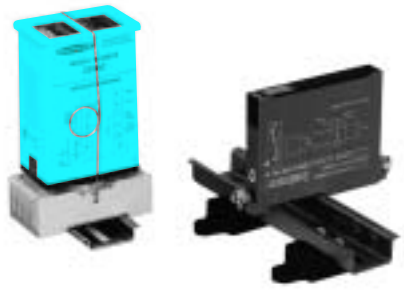
Opposed Mode Emitter and Receiver Hookup



SMI912 Series Retro, Diffuse, Convergent, Glass and Plastic Fiber Optic Hookup

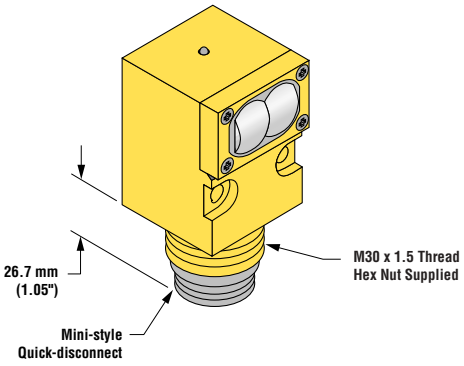


Intrinsic Safety Kits for Use with SMI912 Intrinsically Safe Sensors

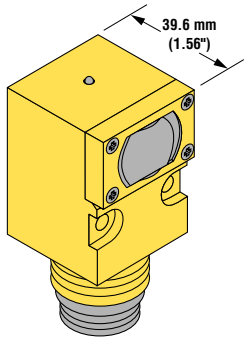
Model	Description	
CI2BK-1	Kit includes a CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount, and one single-channel intrinsically safe barrier (barriers also sold separately - see below)	
CI2BK-2	Typically used in Opposed Mode setups, this kit includes a CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount, and dual-channel intrinsically safe barrier (barriers also sold separately - see below)	
CIB-1	Single-channel barrier	
CI2B-1	Dual-channel barrier	

SMI912 Series Dimensions

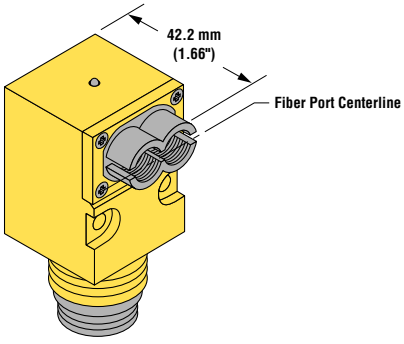
SMI912 Series Opposed, Retro, and Diffuse Sensing Modes (model suffix E, ESR, R, RSR, LV, D & DSR)



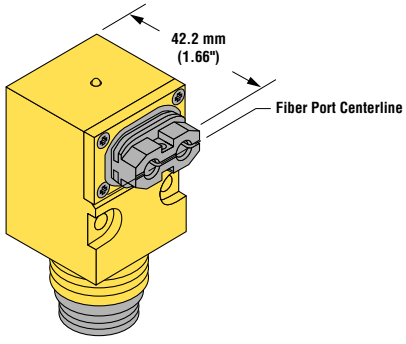
SMI912 Series Sensor - Convergent Mode (model suffix LVAG & CV)



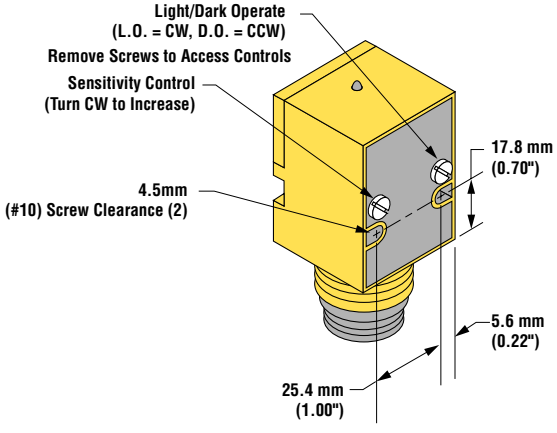
SMI912 Series Sensor - Glass Fiber Optic Mode (model suffix F, EF & RF)



SMI912 Series Sensor - Plastic Fiber Optic Mode (model suffix FP)



SMI912 Series Sensor - Rear View



NOTES:

SM91EN/RN Series Sensors

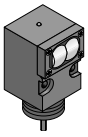
Enhanced Sunlight Immunity

VALU-BEAM SM91EN/RN Series quick-disconnect and cabled models shown

- Opposed mode sensing to 30 m (100') with enhanced sunlight immunity for difficult outdoor applications, or for indoor applications where there is intense light
- Choice of three modulation codes to allow adjacent sensor pairs to operate without crosstalk
- 10 to 30V dc operation; receivers have bipolar solid-state outputs: one NPN (sinking) and one PNP (sourcing)
- Circuitry is totally encapsulated in a rugged, molded thermoplastic polyester housing; rated IP67, NEMA 6P
- Exceptional EMI-RFI immunity

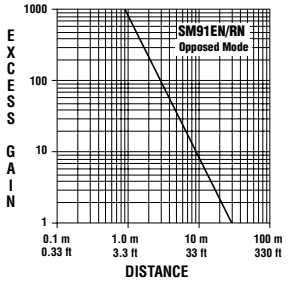
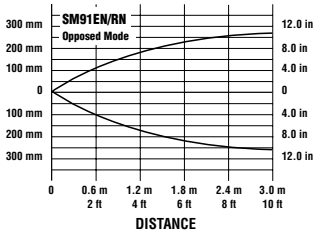
SM91EN/RN Series Sensing Mode Options

Opposed



Infrared, 880 nm

SM91EN Opposed Mode Emitter (E) and SM91RN Receiver (R) - Modulation Code A

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern†
SM91EAN **SM91EANQD** **SM91RAN** **SM91RANQD**	30 m (100')	2 m (6.5') 3-Pin Mini QD 2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		Effective Beam: 25 mm 

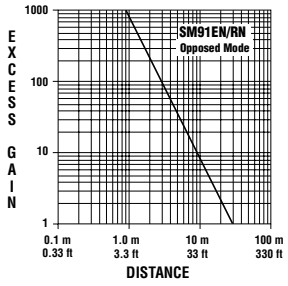
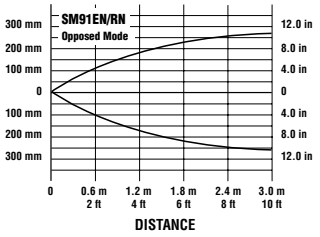
† Note: Beam Pattern response shown from 0 to 3 m (Excess Gain = 100x at 3 m)

For VALU-BEAM SM91EN/RN Series Sensors:

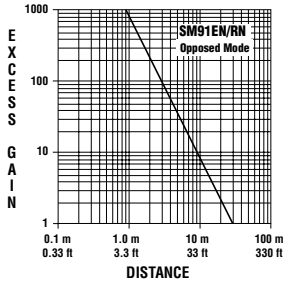
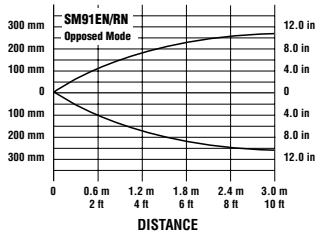
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **SM91EAN W/30**)

ii) A model with a QD connector requires an accessory mating cable. See pages 368 and the Accessories section for more information.

SM91EN Opposed Mode Emitter (E) and SM91RN Receiver (R) - Modulation Code B

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern†
SM91EBN **SM91EBNQD** **SM91RBN** **SM91RBNQD**	30 m (100')	2 m (6.5') 3-Pin Mini QD 2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		Effective Beam: 25 mm 

SM91EN Opposed Mode Emitter (E) and SM91RN Receiver (R) - Modulation Code C

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern†
SM91ECN **SM91ECNQD** **SM91RCN** **SM91RCNQD**	30 m (100')	2 m (6.5') 3-Pin Mini QD 2 m (6.5') 4-Pin Mini QD	10-30V dc	Bipolar NPN/PNP		Effective Beam: 25 mm 

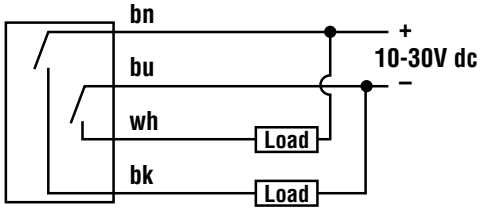
† Note: Beam Pattern response shown from 0 to 3 m (Excess Gain = 100x at 3 m)

SM91EN/RN Series Specifications

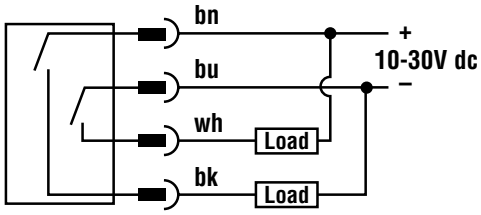
Supply Voltage and Current	10 to 30V dc at 20 mA maximum for receivers (exclusive of load current) and 25 mA maximum for emitters
Output Configuration	Bipolar: one current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Response Time	12 to 28 milliseconds, depending upon code LIGHT operate only
Output Rating	150 mA maximum (continuous, each output) **Off-state leakage** current is 100 microamps, maximum **On-state saturation** voltage less than 1V at 10 mA and less than 2 V at 150 mA (PNP); less than 200 millivolts at 10 mA and less than 1V at 150 mA (NPN)
Indicators	Top-mounted LED indicator - a red LED (on receivers) lights when the output is conducting and pulses at a rate proportional to the strength of the received light signal; a green LED (on emitters) lights when the infrared sensing beam is “ON”
Construction	Reinforced black thermoplastic polyester housing, totally epoxy-encapsulated, replaceable acrylic lenses
Environmental Rating	Meets NEMA 6P and IEC IP67 standards
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables or integral mini-style quick-disconnect (QD) fitting are available
Operating Conditions	**Temperature:** 0° to 70°C (+32 to 158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Water Immersion	Sensors will continue to operate during and after being submerged in water at a depth of 2 m (6') for a period of 48 hours NOTE: Immersion greatly reduces the efficiency of the lens, which results in greatly diminished sensing range
Sunlight Immunity	Receivers may be pointed into a light source of 120,000 lux without false-triggering, and will still respond only to the infrared beam from their modulated emitters. Receivers will not respond to sunlight reflected from water spray droplets.
Strobe Light Immunity	Receivers are totally immune to one Federal Signal Corp. “Fireball” model FB2PST strobe
EMI-RFI Immunity	Emitters and receivers will not respond to transmissions from a 5-watt output walkie-talkie on the test frequencies of 464.500 and 151.625 megahertz when the walkie-talkie’s antenna is held 6" or more away from the sensor.
Certifications	CE ® c ®

SM91EN/RN Series Hookup Diagrams

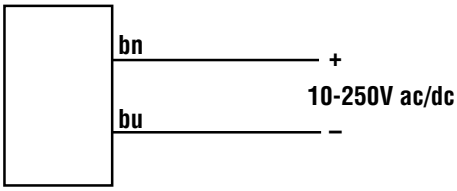
Sensors with Attached Cable



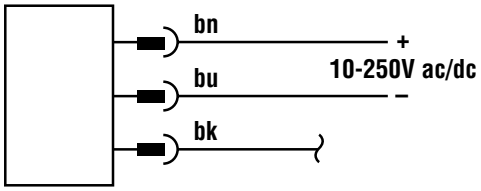
Sensors with Quick-Disconnect



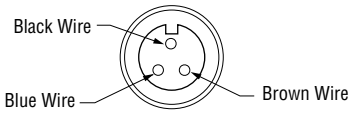
Emitters with Attached Cable



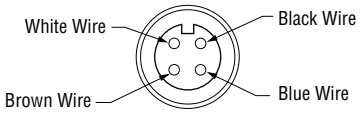
Emitters with Quick-Disconnect



3-Pin Mini-Style Pin-out
(Cable Connector Shown)



4-Pin Mini-Style Pin-out
(Cable Connector Shown)



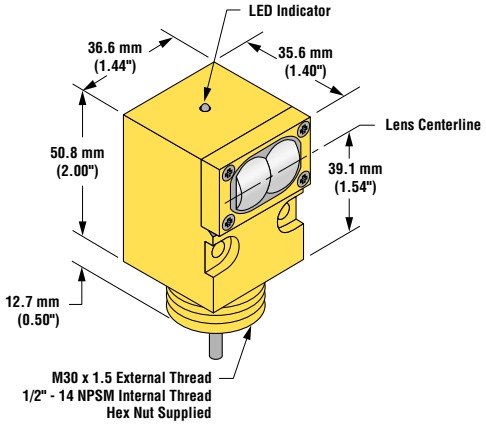
Quick-Disconnect (QD) Option

SM91EN/RN Series VALU-BEAM sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a mini-style QD cable fitting.

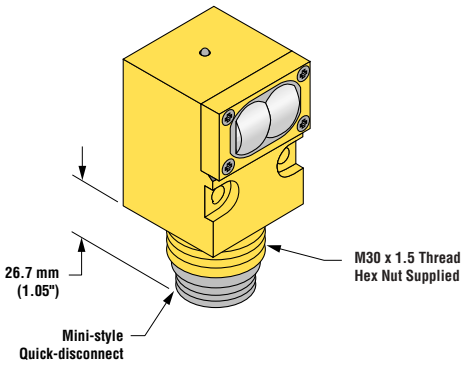
SM91EN/RN QD sensors are identified by the letters “QD” in their model number suffix. Mating cable for QD SM91EN sensors is model MBCC-312. Cable for QD SM91RN sensors is MBCC-412. Cables are supplied in a standard length of 4 m (12'). For more information on QD cables, see page 368 and the Accessories section.

SM91EN/RN Series Dimensions

SM91EN/RN Series Sensor



SM91EN/RN Series Sensor with Quick-Disconnect



Accessories

VALU-BEAM Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All VALU-BEAM sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	SM912D W/30

Quick-Disconnect (QD) Cables

Following is the selection of cables available for VALU-BEAM QD models. See the Accessories section for more cable information.

Style	Model	Length	Connector	Used with:
3-Pin Mini	**MBCC-306** **MBCC-312** **MBCC-330**	2 m (6.5') 4 m (12') 9 m (30')	Straight Straight Straight	All VALU-BEAM emitters 912 Series ac 990 Series
4-Pin Mini	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')	Straight Straight Straight	912 Series dc SM91RN (sunlight immune)
5-Pin Mini	**MBCC-506** **MBCC-512** **MBCC-530**	2 m (6.5') 4 m (12') 9 m (30')	Straight Straight Straight	915 Series
3-Pin Mini	**SMICC-306** **SMICC-312** **SMICC-330**	2 m (6.5') 4 m (12') 9 m (30')	Straight Straight Straight	SMI912 Series (intrinsically safe)

Cabling Accessories

Model	Description	
AC-6	2 m (6.5') armored cable jacket	I.D. 5/16"; O.D. 7/16"
PVC-6	2 m (6.5') flexible PVC tubing (not for QD models)	I.D. 1/4"; O.D. 3/8"
RF1-2NPS	Compression fitting for attaching armored cable or PVC tubing	—
HF1-2NPS	• Flexible black nylon cable protector • Includes a neoprene gland that compresses around the VALU-BEAM cable to provide an additional seal against moisture • Resistant to gasoline, alcohol, oil, grease, solvents and weak acids • Working temperature range of -30° to +100°C (-22° to +212°F)	

Replacement Lens Assemblies

VALU-BEAM lens assemblies are field-replaceable. In addition, some lenses may be used to convert from one sensing mode to another, or to change the sensing range of a particular sensor. The possible conversions are listed in the table below.

Model	Description	Possible Sensing Mode or Range Changes	
UC-900AG	Replacement lens for LVAG	Change LV to LVAG	
UC-900C	Replacement lens for C and CV	Change LV to CV	
UC-900DSR	Replacement lens for DSR, ESR & RSR	Change D or F to DSR, EF to ESR and RF to RSR	
UC-900F	Replacement lens for F	Change D to F and DSR to F	
UC-900FP	Replacement lens for FP	–	
UC-900L	Replacement lens for E, R, LV & D	Change LVAG to LV, CV to LV, DSR to D & F to D	
UC-900J	Attach to VALU-BEAMs E, R, ESR, RSR, LV and D	Flat Lexan® dust cover	

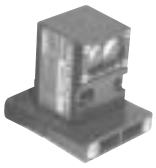
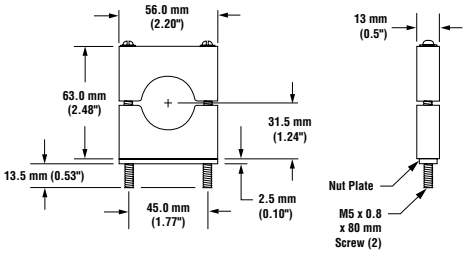
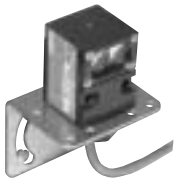
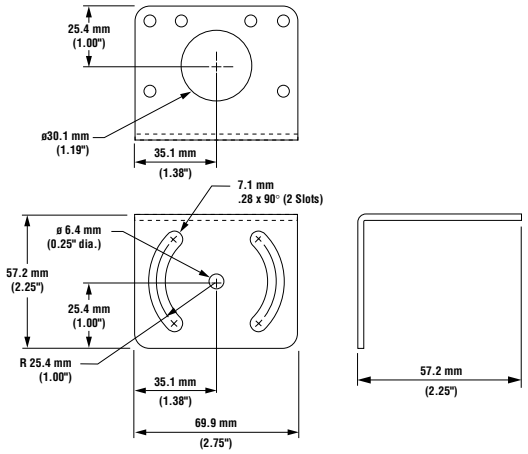
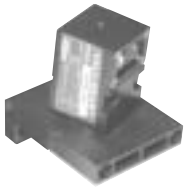
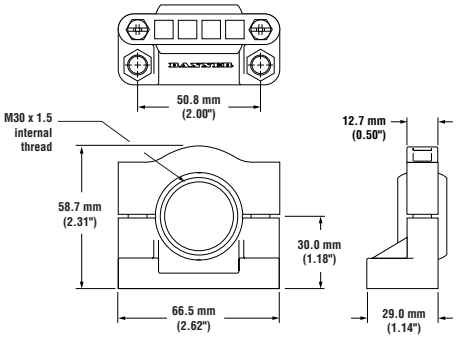
Lexan® is a registered trademark of General Electric Co.

Extension Cables (without connectors)

The following cables are available for extending the length of existing sensor cable. These are 30 m (100') lengths of VALU-BEAM cable. This cable may be spliced to existing cable. Connectors, if used, must be customer-supplied.

Model	Type	Used with:
EC312-100	4-conductor	SM912 Series dc sensors
EC312A-100	2-conductor	For all emitters, SM2A912 Series ac sensors and 990 Series sensors
EC915-100	5-conductor	915 Series sensors

Mounting Brackets

Model	Description	Dimensions
SMB30C 	• 30 mm split clamp bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting hardware	
SMB30MM 	• 30 mm, 12-gauge, stainless steel bracket with curved mounting slots for versatility and orientation • Clearance for M6 (1/4") hardware	
SMB30SC 	• 30 mm swivel bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting and swivel locking hardware	

Retroreflective Targets

Banner offers a wide selection of high-quality retroreflective targets. See Accessories section for complete information.

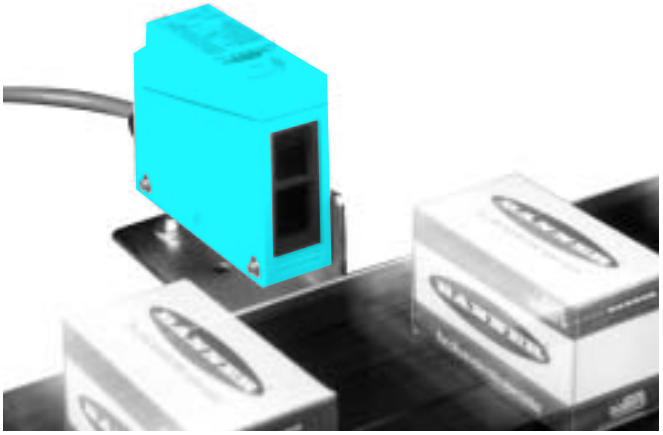
Q85 Sensors

CE

NRTL/C

Q85 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

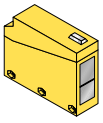
Q85 Sensors



- Q85 sensors are available in three electrical configurations:
  - **Q85VR3 Series:**
    - 24 to 240V ac or 12 to 240V dc supply voltage
    - 3 amp electromechanical output relay
  - **Q85BW13 Series:**
    - 24 to 240V ac or 12 to 240V dc supply voltage
    - SPST 0.3 amp isolated solid-state output switch
  - **Q85BB62 Series**:
    - 10 to 48V dc supply voltage
    - Bipolar solid-state outputs (one NPN sinking and one PNP sourcing); alternative low-saturation hookup for TTL compatibility

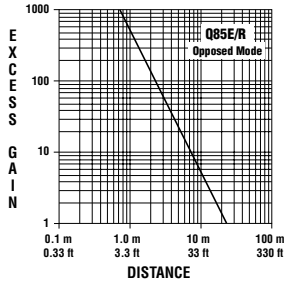
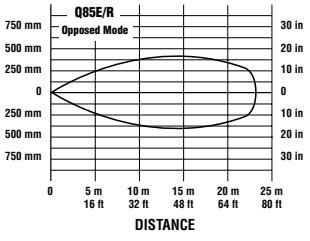
- "T9" model suffix indicates programmable output timing:
  - ON/OFF (no delay)
  - ON delay
  - OFF delay
  - ON & OFF delay
  - One-shot (pulse timer)
  - ON-delayed one-shot
  - Limit timer
  - On-delayed limit timer

Q85 Sensing Mode Options



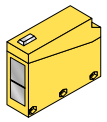
Visible red, 680 nm

Q85 Opposed Mode Emitter (E) and Receiver (R)

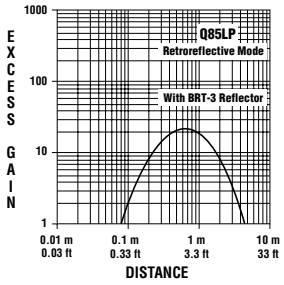
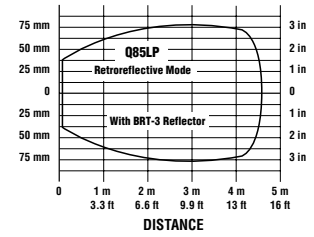
Models	Range	Supply Voltage	Output Type	Output Timing	Excess Gain	Beam Pattern
Q853E	23 m (75')	12-240V dc 24-240V ac	–	–		Effective Beam: 9.6 mm 
Q85VR3R			SPDT E/m Relay	No		
Q85VR3R-T9				Yes		
Q853E			–	–		
Q85W13R			SPST Solid-state Switch	No		
Q85BW13R-T9				Yes		
Q8562E		10-48V dc	–	–		
Q85BB62R			Bipolar NPN/PNP	No		
Q85BB62R-T9				Yes		

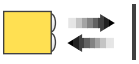
Visible red, 680 nm

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

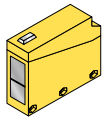


Q85 Polarized Retroreflective Mode

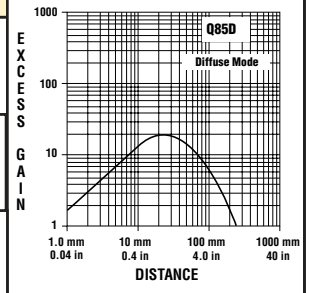
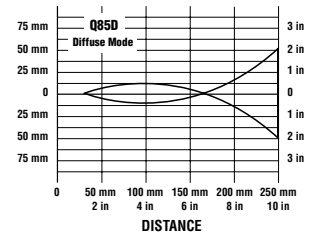
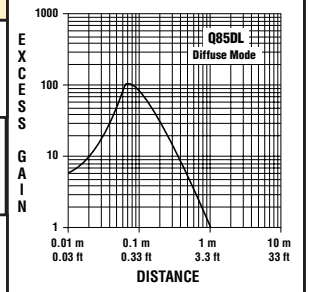
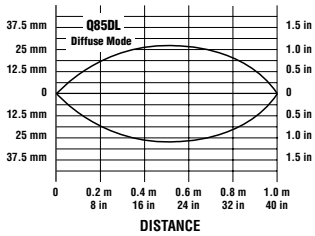
Models	Range	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q85VR3LP **Q85VR3LP-T9**	80 mm - 4.6 m (3" - 15') w/BRT-3 target	12-240V dc 24-240V ac	SPDT E/m Relay		
Q85BW13LP **Q85BW13LP-T9**			SPST Solid-state Switch		
Q85BB62LP **Q85BB62LP-T9**		10-48V dc	Bipolar NPN/PNP		



Infrared, 880 nm



Q85 Diffuse Mode

Models	Range	Supply Voltage	Output Type	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
Short Range					
Q85VR3D **Q85VR3D-T9**	250 mm (10")	12-240V dc 24-240V ac	SPDT E/m Relay		
Q85BW13D **Q85BW13D-T9**			SPST Solid-state Switch		
Q85BB62D **Q85BB62D-T9**		10-48V dc	Bipolar NPN/PNP		
Long Range					
Q85VR3DL **Q85VR3DL-T9**	1 m (39")	12-240V dc 24-240V ac	SPDT E/m Relay		
Q85BW13DL **Q85BW13DL-T9**			SPST Solid-state Switch		
Q85BB62DL **Q85BB62DL-T9**		10-48V dc	Bipolar NPN/PNP		

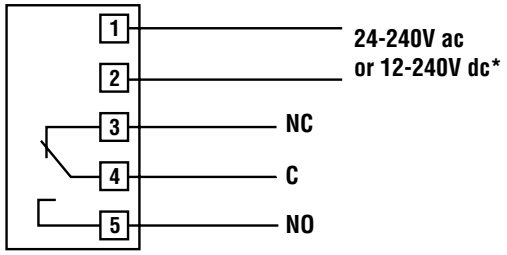
Q85VR3 Series Specifications

Supply Voltage and Current	24 to 240V ac, 50/60 Hz or 12 to 240V dc (2 watts maximum)
Supply Protection Circuitry	Protected against transient voltages. DC hookup is without regard to polarity.
Output Configuration	Q85VR3x models - SPDT e/m relay, on/off output Q85VR3x-T9 models - SPDT e/m relay, programmable timer
Output Rating	Maximum switching power (resistive load): 90W, 750 VA Maximum switching voltage (resistive load): 250V ac or 30V dc Maximum switching current (resistive load): 3A Minimum voltage and current: 5V dc, 10 mA Mechanical life: 50,000,000 operations Electrical life at full resistive load: 100,000 operations
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	Closure time (no time logic in use): 20 milliseconds max. Release time (no time logic in use): 20 milliseconds max. Maximum switching speed: 25 operations per second
Repeatability	All sensing modes (no time logic in use): 1 millisecond
Adjustments	Single-turn SENSITIVITY control potentiometer, accessible beneath the ABS wiring chamber cover. Timing logic (for T9 models) is configured at a DIP switch. Pulse length and delay are set by a single-turn potentiometer (under the wiring chamber cover). The adjustable time range for both functions is 0.1 to 5 seconds; both functions are automatically set to the same value.
Indicators	Exclusive Alignment Indicating Device system (AID™, US patent #4356393) lights a red LED indicator whenever the sensor sees its own modulated light, and pulses at a rate proportional to the strength of the light signal. Yellow indicator lights whenever the sensor's output is energized.
Construction	Yellow Cycolac® ABS housing, acrylic lenses, and steel-plated hardware. Maximum wire size (for connection to wiring terminals) is #14 AWG.
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 6P, 12, and 13; IEC IP67
Operating Operations	**Temperature:** -25° to +55°C (-13° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Vibration and Mechanical Shock	Meets Mil. Std. 202F requirements. Method 201A (Vibration: frequency 10 to 55 Hz max., double-amplitude 0.06", max. acceleration 10G) Method 213B conditions H & I (Shock: 75G with unit operating; 100G for non-operation)
Application Notes	Install transient suppressor (MOV) across contacts switching inductive loads.
Certifications	CE NRTL/C

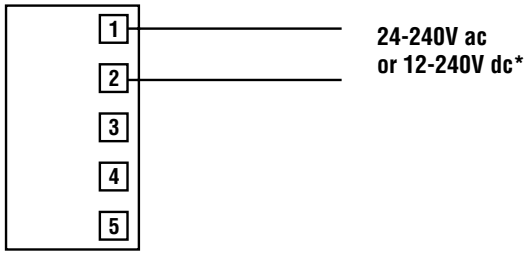
Cycolac® is a registered trademark of General Electric Co.

Q85VR3 Series Hookup Diagrams

Q85VR3 Series



Q853E Emitter



*NOTE: Connection of dc power is without regard to polarity

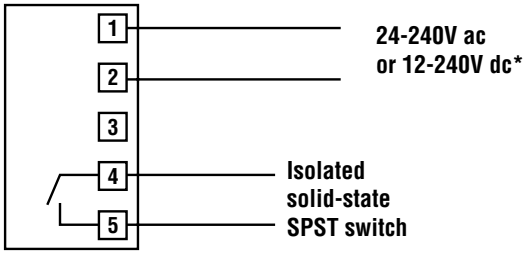
Q85BW13 Series Specifications

Supply Voltage and Current	24 to 240V ac, 50/60 Hz or 12 to 240V dc (2 watts maximum)
Supply Protection Circuitry	Protected against transient voltages. DC hookup is without regard to polarity.
Output Configuration	Q85BW13x models - optically isolated SPST solid-state switch, on/off output Q85BW13x-T9 models - optically isolated SPST solid-state switch, programmable timer
Output Rating	250V ac, 250V dc, 300 mA **Output saturation voltage** 3V at 300 mA, 2V at 15 mA **Off-state leakage current** <50 microamps **Inrush current** 1 amp for 20 milliseconds, non-repetitive
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time and Repeatability	Response time and repeatability are independent of signal strength: Q85BW13R response time 6 ms on/3 ms off, repeatability 750 µs Q85BW13R-T9* response time 12 ms on/9 ms off, repeatability 1 ms Q85BW13LP response time 4 ms on/off, repeatability 1 ms Q85BW13LP-T9* response time 10 ms on/off, repeatability 1 ms Q85BW13D response time 4 ms on/off, repeatability 1 ms Q85BW13D-T9* response time 10 ms on/off, repeatability 1 ms Q85BW13DL response time 4 ms on/off, repeatability 1 ms Q85BW13DL-T9* response time 10 ms on/off, repeatability 1 ms *on/off operation (no timing in use)
Adjustments	Single-turn SENSITIVITY control potentiometer, accessible beneath the ABS wiring chamber cover. Timing logic (for T9 models) is configured at a DIP switch. Pulse length and delay are set by a single-turn potentiometer (under the wiring chamber cover). The adjustable time range for both functions is 0.1 to 5 seconds; both functions are automatically set to the same value. All models have a light/dark operate switch.
Indicators	Exclusive Alignment Indicating Device system (AID™, US patent #4356393) lights a red LED indicator whenever the sensor sees its own modulated light, and pulses at a rate proportional to the strength of the light signal. Yellow indicator lights whenever the sensor's output is conducting.
Construction	Yellow Cycolac® ABS housing, acrylic lenses, and steel-plated hardware. Maximum wire size (for connection to wiring terminals) is #14 AWG.
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 6P, 12, and 13; IEC IP67
Operating Operations	**Temperature:** -25° to +55°C (-13° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Vibration and Mechanical Shock	Meets Mil. Std. 202F requirements. Method 201A (Vibration: frequency 10 to 55 Hz max., double-amplitude 0.06", max. acceleration 10G) Method 213B conditions H & I (Shock: 75G with unit operating; 100G for non-operation)
Certifications	CE NRTL/C

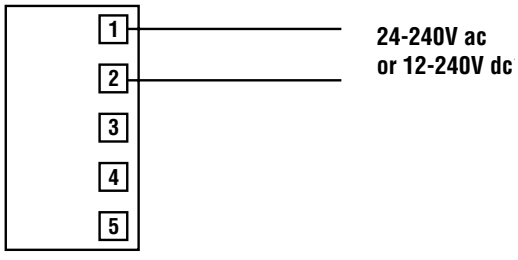
Cycolac® is a registered trademark of General Electric Co.

Q85BW13 Series Hookup Diagrams

Q85BW13 Series



Q853E Emitter



*NOTE: Connection of dc power is without regard to polarity

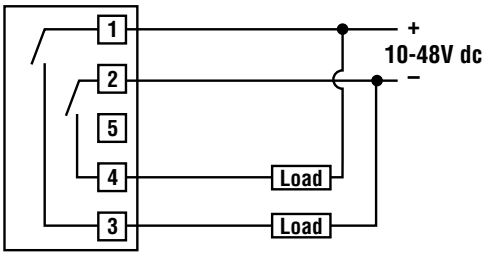
Q85BB62 Series Specifications

Supply Voltage and Current	10 to 48V dc at 50 mA max. exclusive of load; Q8562E emitter requires 25 mA
Supply Protection Circuitry	Protected against reverse-polarity
Output Configuration	Q85BB62x models - NPN sinking and PNP sourcing outputs, on/off output Q85BB62x-T9 models - NPN sinking and PNP sourcing outputs, programmable timer
Output Rating	STANDARD OUTPUTS are solid-state, one NPN, one PNP; 150 mA max (at 25°C, either output). Derate output by 1 mA/°C above 25°C Off-state leakage current <1 µA Output saturation voltage <1V at 10 mA and <2V at 150 mA The two standard outputs may be used simultaneously (max. load 150 mA each output) LOW-SATURATION VOLTAGE ALTERNATIVE NPN OUTPUT is provided for easy interfacing to TTL and similar circuitry Output saturation voltage <200 millivolts at 10 mA and <1V at 150 mA Overload and short circuit protected This output is not reverse polarity protected
Output Protection Circuitry	Protected against false pulse on power-up, overload and short circuit of outputs
Output Response Time and Repeatability	Response time and repeatability are independent of signal strength: Q85BB62R response time 1 ms, repeatability 125 µs Q85BB62R-T9* response time 8 ms, repeatability 1 ms Q85BB62LP response time 1 ms, repeatability 250 µs Q85BB62LP-T9* response time 8 ms, repeatability 1 ms Q85BB62D response time 1 ms, repeatability 250 µs Q85BB62D-T9* response time 8 ms, repeatability 1 ms Q85BB62DL response time 2 ms, repeatability 500 µs Q85BB62DL-T9* response time 8 ms, repeatability 1 ms *on/off operation (no timing in use)
Adjustments	Single-turn SENSITIVITY control potentiometer, accessible beneath the ABS wiring chamber cover. Timing logic (for T9 models) is configured at a DIP switch. Pulse length and delay are set by a single-turn potentiometer (under the wiring chamber cover). The adjustable time range for both functions is 0.1 to 5 seconds; both functions are automatically set to the same value. All models have a light/dark operate switch.
Indicators	Exclusive Alignment Indicating Device system (AID™, US patent #4356393) lights a red LED indicator whenever the sensor sees its own modulated light, and pulses at a rate proportional to the strength of the light signal. Yellow indicator lights whenever the sensor's output is energized.
Construction	Yellow Cycolac® ABS housing, acrylic lenses, and steel-plated hardware. Maximum wire size (for connection to wiring terminals) is #14 AWG.
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 4X, 6, 6P, 12, and 13; IEC IP67
Operating Temperature	**Temperature:** -25° to +55°C (-13° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Vibration and Mechanical Shock	Meets Mil. Std. 202F requirements. Method 201A (Vibration: frequency 10 to 55 Hz max., double-amplitude 0.06", max. acceleration 10G) Method 213B conditions H & I (Shock: 75G with unit operating; 100G for non-operation)
Certifications	CE CSA® NRTL/C

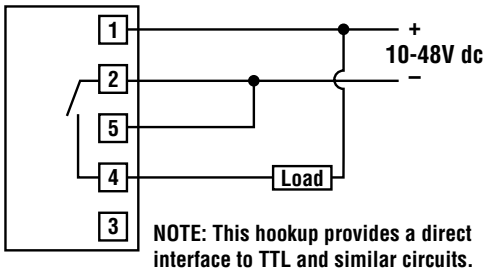
Cycolac® is a registered trademark of General Electric Co.

Q85BB62 Series Hookup Diagrams

Q85BB62 Series
Standard Hookup



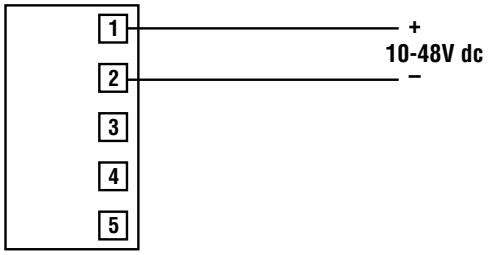
Q85BB62 Series
Alternative Low Saturation Sinking (NPN) Hookup



NOTE: This hookup provides a direct interface to TTL and similar circuits.

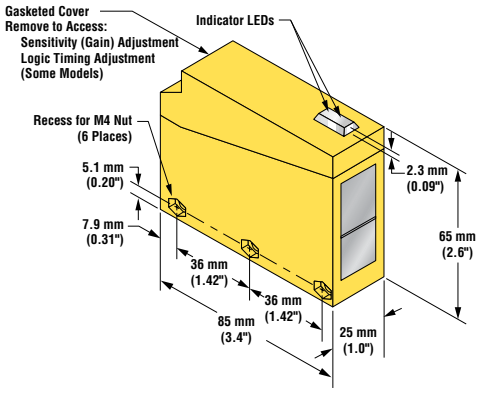
CAUTION: The output is NOT reverse-polarity protected in this wiring configuration.

Q8562E Emitter

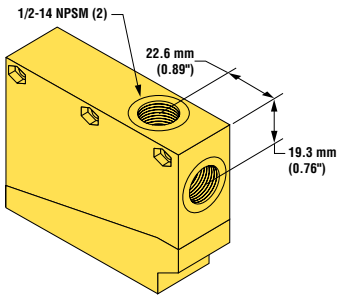


Q85 Dimensions

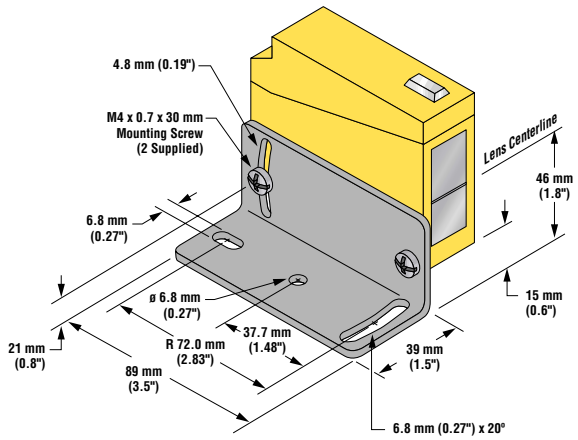
Q85 Sensor



Q85 Sensor - Bottom View



Q85 Series with Model SMB85B Mounting Bracket (supplied with sensor)



Quick-Disconnect (QD) Cables

Following is the selection of cables available for Q85 sensors. See the Accessories section for more cable information.
Note: Use of quick-disconnect cables requires purchase of mating QD receptacle (see, below)

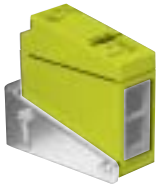
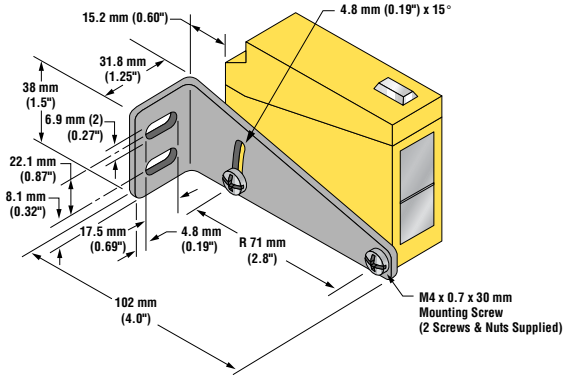
Style	Model	Length	Connector	Used with:
3-Pin Mini	**MBCC-306** **MBCC-312** **MBCC-330**	2 m (6.5') 4 m (12') 9 m (30')	Straight	Q85 emitters
4-Pin Mini	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')	Straight	All Q85 sensors
5-Pin Mini	**MBCC-506** **MBCC-512** **MBCC-530**	2 m (6.5') 4 m (12') 9 m (30')	Straight	All Q85 sensors

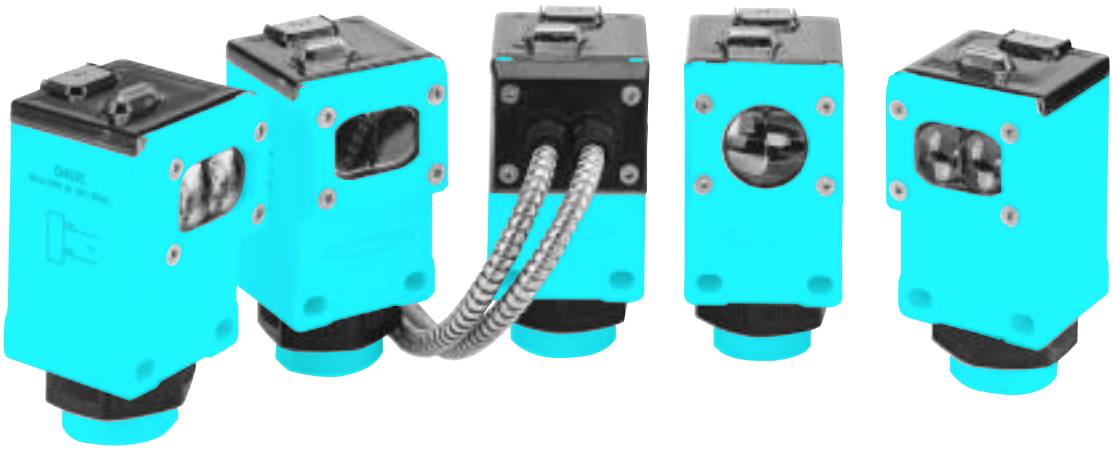
Quick-Disconnect (QD) Receptacles

Following is the selection of receptacles available for Q85 sensors. See the Accessories section for more receptacle information.

Style	Model	Wire Length	Used with:
3-Pin Mini	**MBC-3**	300 mm (12")	Q85 emitters
4-Pin Mini	**MBC-4**	300 mm (12")	All Q85 sensors
5-Pin Mini	**MBC-5**	300 mm (12")	All Q85 sensors

Mounting Brackets

Model	Description	
SMB85R 	• Rear mount bracket	



Q45 Sensors

CE (Exceptions noted)

cULus (Except Laser Retro, page 382; other exceptions noted) (Exceptions noted)

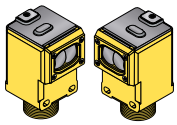
⚠ Q45 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

Q45 Series Sensors

Q45 Series opposed mode shown

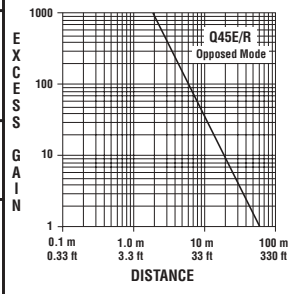
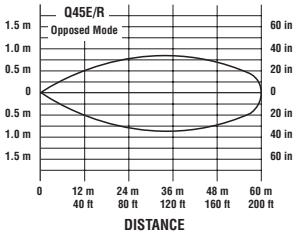
- Select models for dc or ac operation:
  - 10 to 30V dc
  - 90 to 250V ac
  - Universal voltage: 12 to 250V dc or 24 to 250V ac
- Choose either electromechanical relay for switching large loads or solid-state output for unlimited life
- Internal light/dark operate switch and multi-turn SENSITIVITY (Gain) control accessible beneath hinged, o-ring sealed top cover
- Retroreflective models include laser versions for very long range or precise sensing
- Optional expansion cards are available for output timing and/or a 7-segment signal strength display (see page 422)

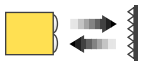
Q45 Sensing Mode Options



Infrared, 880 nm

Q45 Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q456E **Q456EQ** **Q456EQ5**	60 m (200')	2-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	None		Effective Beam: 13 mm 
Q45BB6R **Q45BB6RQ** **Q45BB6RQ5**		4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD		Bipolar NPN/PNP		
Q452E **Q452EQ** **Q452EQ1**		2-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD	90-250V ac	None		
Q45VR2R **Q45VR2RQ**		5-wire 2 m (6.5') 5-Pin Mini QD		SPDT e/m Relay		
Q45BW22R **Q45BW22RQ** **Q45BW22RQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q453E **Q453EQ**		2-wire 2 m (6.5') 3-Pin Mini QD	Universal 12-250V dc or 24-250V ac	None		
Q45VR3R **Q45VR3RQ**		5-wire 2 m (6.5') 5-Pin Mini QD		SPDT e/m Relay		
Q45BW13R **Q45BW13RQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state Relay		

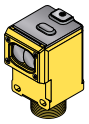


Visible red, 680 nm

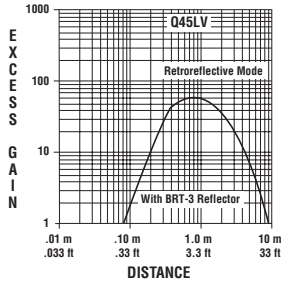
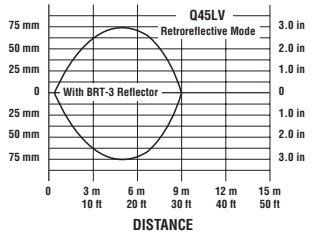
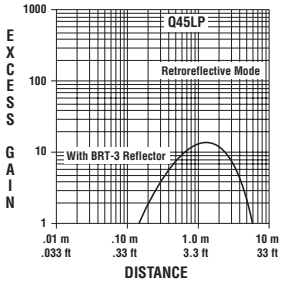
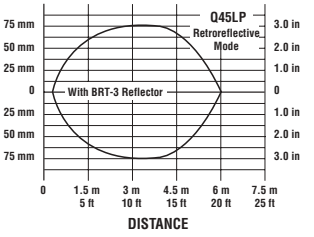
Non-Polarized

Polarized

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



Q45 Series Retroreflective Mode

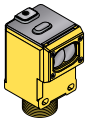
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
Q45BB6LV **Q45BB6LVQ** **Q45BB6LVQ5**	0.08 - 9 m (3" - 30')	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2LV **Q45VR2LVQ**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22LV **Q45BW22LVQ** **Q45BW22LVQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3LV **Q45VR3LVQ**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13LV **Q45BW13LVQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state Relay		
Polarized*						
Q45BB6LP **Q45BB6LPQ** **Q45BB6LPQ5**	0.15 - 6 m (6"- 20')	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2LP **Q45VR2LPQ**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22LP **Q45BW22LPQ** **Q45BW22LPQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3LP **Q45VR3LPQ**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13LP **Q45BW13LPQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state Relay		

* Use polarized models when shiny objects will be detected.

For Q45 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q45VR2LP W/30**)

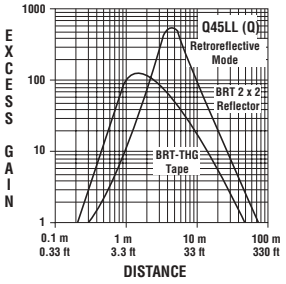
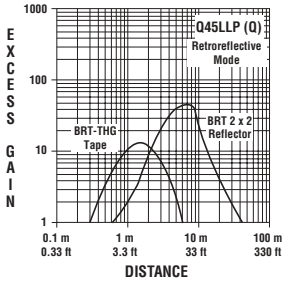
ii) A model with a QD connector requires an accessory mating cable. See page 421 and the Accessories section for more information.

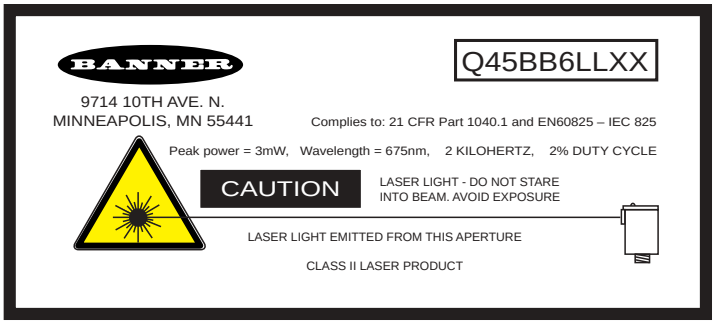


- Class II visible laser diode emitter brings high power and small effective beam to retroreflective sensing applications
- Use for long-range retroreflective sensing or take advantage of the narrow beam of the laser light source for sensing small objects or for precision sensing of object edge position
- Choose non-polarized models for the longest range, or polarized models when highly reflective objects must be sensed

Visible red, 670 nm
Non-Polarized *Polarized*

Visible Laser Retroreflective Mode

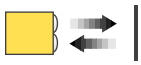
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain
Non-Polarized					
Q45BB6LL **Q45BB6LLQ** **Q45BB6LLQ6**	0.3 - 70 m (1 - 225') w/BRT-2x2 (included with sensor)	5-wire 2 m (6.5') 5-Pin Mini QD 5-Pin Euro QD	10-30V dc	Bipolar NPN/PNP	
Polarized					
Q45BB6LLP **Q45BB6LLPQ** **Q45BB6LLPQ6**	0.6 - 40 m (2 - 130') w/BRT-2x2 (included with sensor)	5-wire 2 m (6.5') 5-Pin Mini QD 5-Pin Euro QD	10-30V dc	Bipolar NPN/PNP	



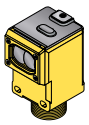
For Q45 Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q45VR2DL W/30**)

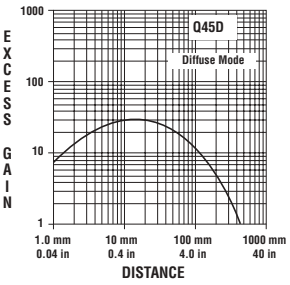
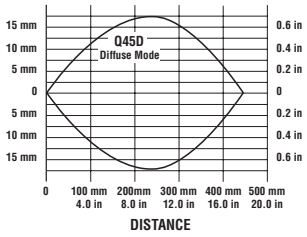
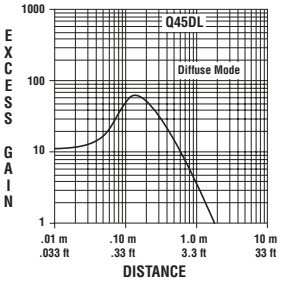
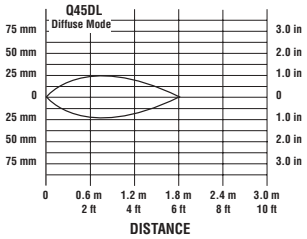
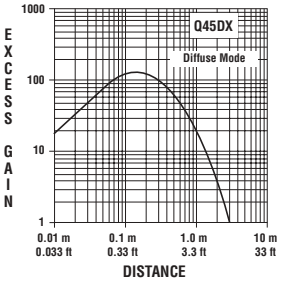
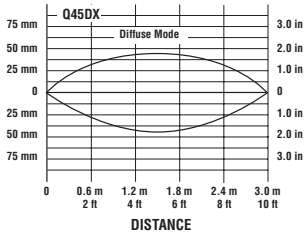
ii) A model with a QD connector requires an accessory mating cable. See page 421 and the Accessories section for more information.

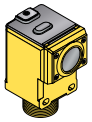


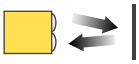
Infrared, 880 nm



Q45 Diffuse Mode

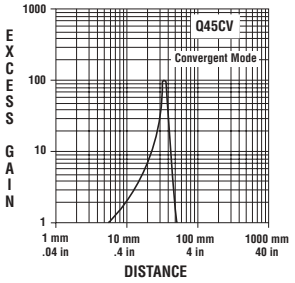
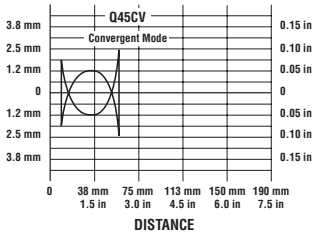
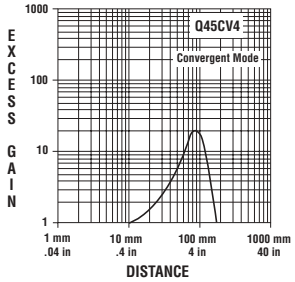
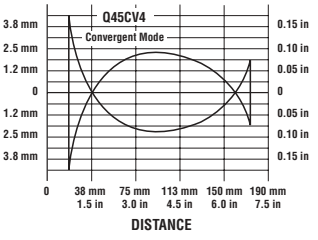
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Short Range						
Q45BB6D **Q45BB6DQ** **Q45BB6DQ5**	450 mm (18")	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2D **Q45VR2DQ**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22D **Q45BW22DQ** **Q45BW22DQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3D **Q45VR3DQ**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13D **Q45BW13DQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state		
Long Range						
Q45BB6DL **Q45BB6DLQ** **Q45BB6DLQ5**	1. 8 m (6')	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2DL **Q45VR2DLQ**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22DL **Q45BW22DLQ** **Q45BW22DLQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3DL **Q45VR3DLQ**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13DL **Q45BW13DLQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state		
High Power						
Q45BB6DX **Q45BB6DXQ** **Q45BB6DXQ5**	3 m (10')	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2DX **Q45VR2DXQ**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22DX **Q45BW22DXQ** **Q45BW22DXQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3DX **Q45VR3DXQ**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13DX **Q45BW13DXQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state		





Visible red, 680 nm

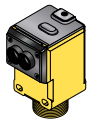
Q45 Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Q45BB6CV **Q45BB6CVQ** **Q45BB6CVQ5**	38 mm (1.5") Spot Size at Focus: 1.3 mm (0.05")	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2CV **Q45VR2CVQ**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22CV **Q45BW22CVQ** **Q45BW22CVQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3CV **Q45VR3CVQ**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13CV **Q45BW13CVQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state Relay		
Q45BB6CV4 **Q45BB6CV4Q** **Q45BB6CV4Q5**	100 mm (4") Spot Size at Focus: 1.5 mm (0.06")	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2CV4 **Q45VR2CV4Q**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22CV4 **Q45BW22CV4Q** **Q45BW22CV4Q1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3CV4 **Q45VR3CV4Q**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13CV4 **Q45BW13CV4Q**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state Relay		

For Q45 Series Sensors:

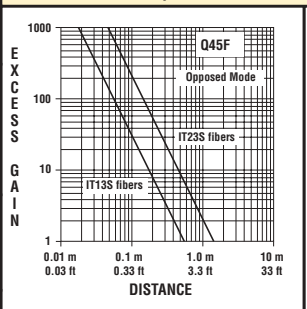
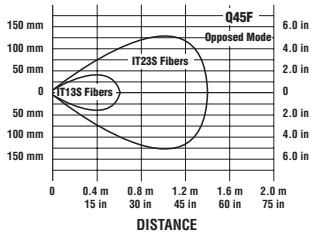
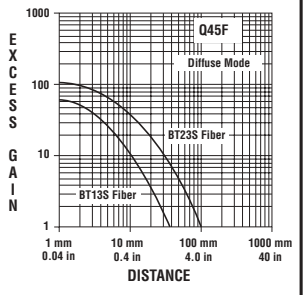
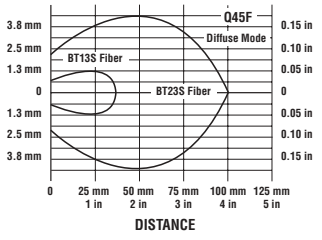
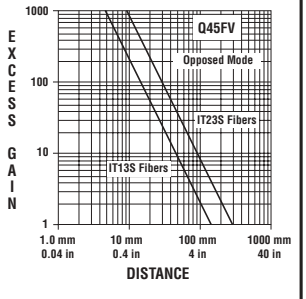
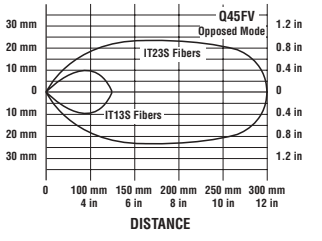
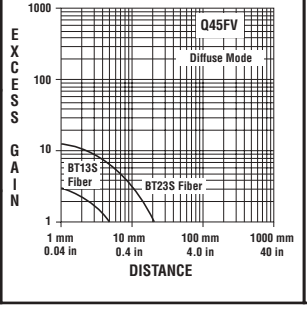
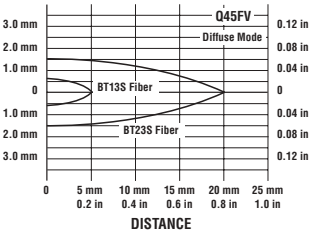
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q45BB6F W/30**)

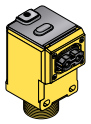
ii) A model with a QD connector requires an accessory mating cable. See page 421 and the Accessories section for more information.

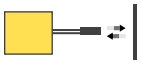


See sensing beam information below

Q45 Glass Fiber Optic

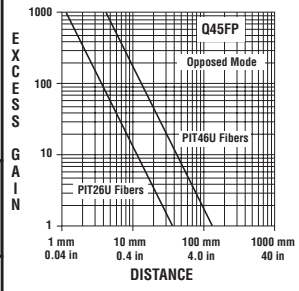
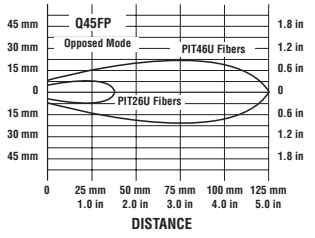
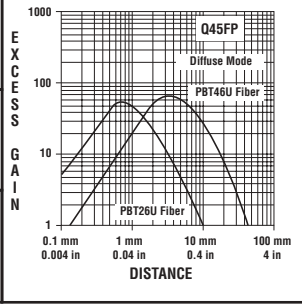
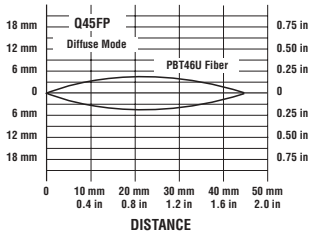
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Infrared, 880 nm						
Q45BB6F **Q45BB6FQ** **Q45BB6FQ5**	Range varies by sensing mode and fiber optics used	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2F **Q45VR2FQ**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22F **Q45BW22FQ** **Q45BW22FQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3F **Q45VR3FQ**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13F **Q45BW13FQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state Relay		
Visible Red, 650 nm						
Q45BB6FV **Q45BB6FVQ** **Q45BB6FVQ5**	Range varies by sensing mode and fiber optics used	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2FV **Q45VR2FVQ**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22FV **Q45BW22FVQ** **Q45BW22FVQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3FV **Q45VR3FVQ**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13FV **Q45BW13FVQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state Relay		





Visible red, 660 nm

Q45 Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Q45BB6FP **Q45BB6FPQ** **Q45BB6FPQ5**	Range varies by sensing mode and fiber optics used	4-wire 2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bipolar NPN/PNP		
Q45VR2FP **Q45VR2FPQ**		5-wire 2 m (6.5') 5-Pin Mini QD	90-250V ac	SPDT e/m Relay		
Q45BW22FP **Q45BW22FPQ** **Q45BW22FPQ1**		3-wire 2 m (6.5') 3-Pin Mini QD 4-Pin Micro QD		SPST Solid-state Relay		
Q45VR3FP **Q45VR3FPQ**		5-wire 2 m (6.5') 5-Pin Mini QD	Universal 12-250V dc or 24-250V ac	SPDT e/m Relay		
Q45BW13FP **Q45BW13FPQ**		4-wire 2 m (6.5') 4-Pin Mini QD		SPST Solid-state Relay		

For Q45 Series Sensors:

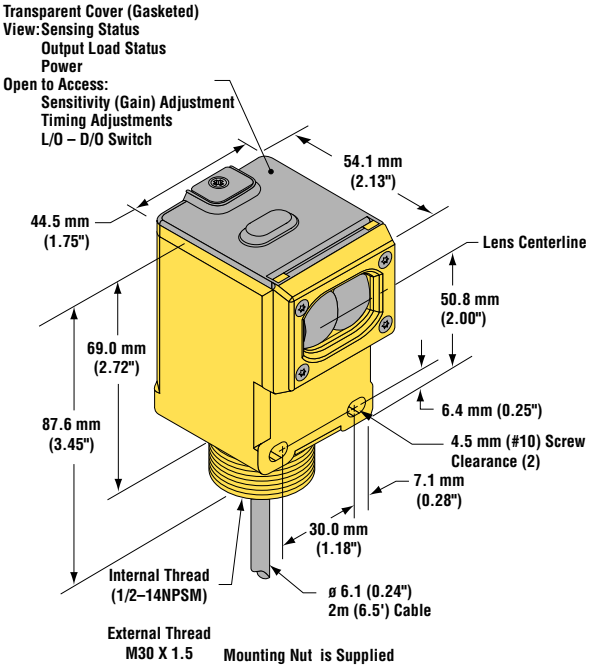
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q45BB6FP W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 421 and the Accessories section for more information.

Q45 Dimensions

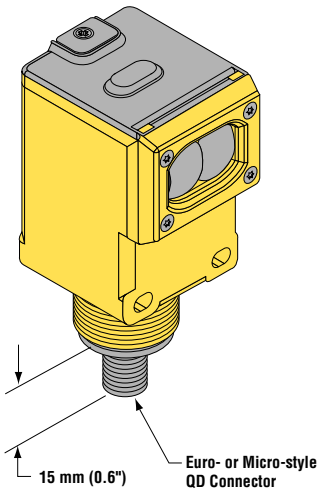
Q45 Series Opposed, Retro, and Diffuse Sensing Modes (model suffix E, R, D, DL, DX, LV & LP)

Cabled

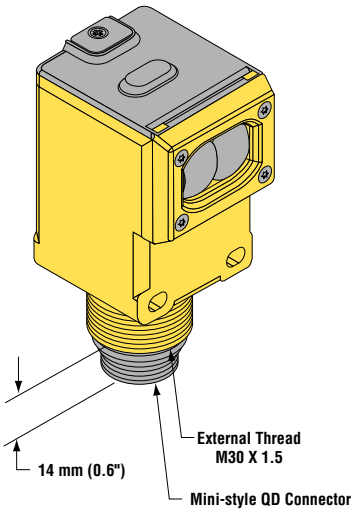


Quick-Disconnect

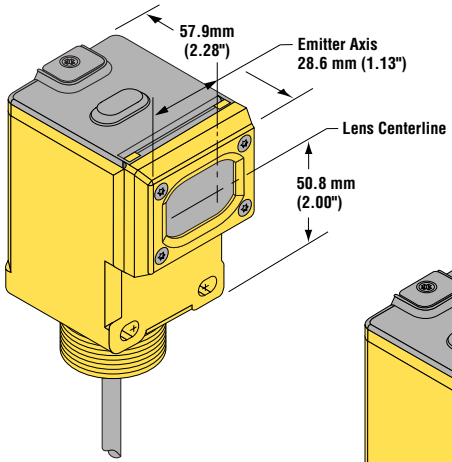
Euro- and Micro-Style



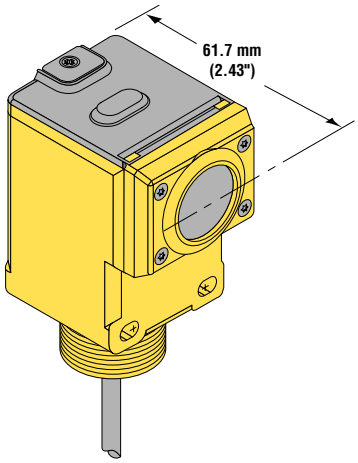
Mini-Style



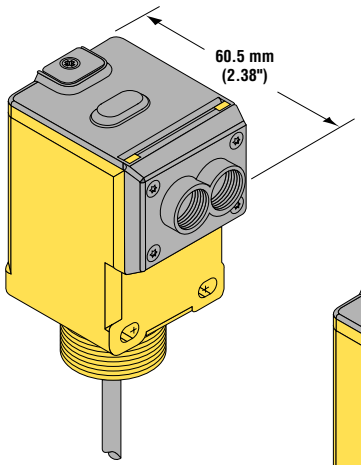
Retroreflective Laser (model suffix LL & LLP)



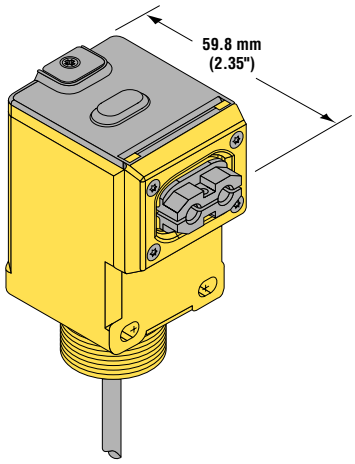
Convergent Sensing Mode (model suffix CV & CV4)



Glass Fiber Optic (model suffix F & FV)



Plastic Fiber Optic (model suffix FP)



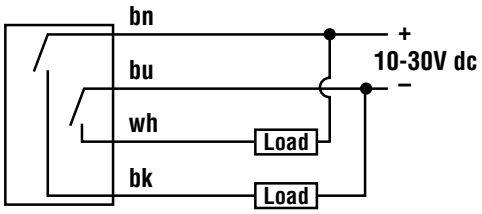
Q45BB6 Series DC Specifications (except Retroreflective Laser, see p. 382)

Supply Voltage and Current	10 to 30V dc (10% maximum ripple), at less than 50 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: one current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	250mA maximum each output up to 50°C, derated to 150 mA at 70°C (derate 5 mA/°C) **Off-state leakage** current less than 1 microamp **Output saturation voltage** (both outputs) less than 1 volt at 10 mA and less than 2 volts at 250 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs
Output Response Time	**Opposed mode:** 2 milliseconds ON and 1 millisecond OFF; **All other sensing modes:** 2 milliseconds ON/OFF (NOTE: 100 millisecond delay on power-up. Output is non-conducting during this time.)
Repeatability	**Opposed mode:** 0.25 milliseconds; **All sensing modes:** 0.5 milliseconds Response time and repeatability specifications are independent of signal strength.
Adjustments	**Beneath sensor's transparent cover:** Light/Dark Operate select switch, and multi-turn sensitivity control on top of sensor, beneath a transparent o-ring sealed Lexan® cover, allows precise sensitivity setting (turn clockwise to increase gain). Optional logic and logic/display modules have adjustable timing functions.
Indicators	Indicator LEDs are highly visible, located beneath a raised transparent Lexan® dome on top of the sensor. **Power (green) LED** lights whenever 10 to 30V dc power is applied, and flashes to indicate output overload or output short circuit **Signal (red) AID™ system LED** lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the strength of the received light signal **Load (yellow) LED** lights whenever an output is conducting **Optional 7-element LED** signal strength display module
Construction	Molded reinforced thermoplastic polyester housing, o-ring sealed transparent Lexan® cover, molded acrylic lenses, and stainless steel hardware. Q45s are designed to withstand 1200 psi washdown. The base of cabled models has a ½" NPS integral internal conduit thread.
Environmental Rating	NEMA 6P, IEC IP 67
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or 4-pin mini-style ("Q" suffix models) or 4-pin euro-style ("Q5" suffix models) quick-disconnect (QD) fittings are available. QD cables are ordered separately. See page 421 and Accessories section.
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Optional logic timing modules are available. See page 422 for more information.
Certifications	CE, CSA®, UL LISTED

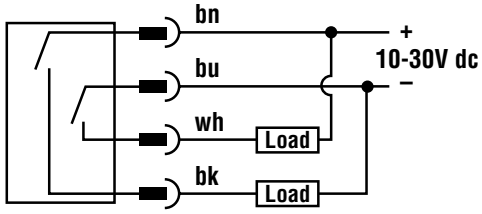
Lexan® is a registered trademark of General Electric Co.

Q45BB6 Series DC Hookup Diagrams (except Retroreflective Laser, see p. 382)

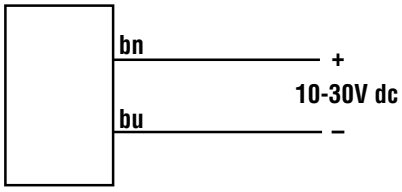
Sensors with Attached Cable



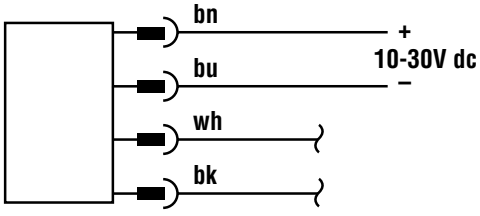
Sensors with Quick-Disconnect 4-Pin Mini-Style or 4-Pin Euro-Style



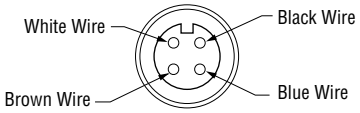
Q456E Emitters with Attached Cable



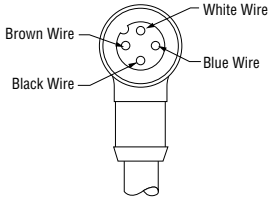
Q456EQ or Q456EQ5 Emitter 4-Pin Mini-Style or 4-Pin Euro-Style



"Q" Model Suffix 4-Pin Mini-Style Pin-out (Cable Connector Shown)



"Q5" Model Suffix 4-Pin Euro-Style Pin-out (Cable Connector Shown)



Quick-Disconnect (QD) Option

DC Q45BB6 Series sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 4-pin Mini-style or 4-pin Euro-style QD cable fitting.

DC 4-pin Mini-style QD sensors are identified by the letter "Q" in their model number suffix and 4-pin Euro-style are identified by the letters "Q5". Mating cables for QD Q45BB6 sensors are specified on page 421 and in the Accessories section.

Q45BB6 Retroreflective Laser Series DC Specifications

Supply Voltage and Current	10 to 30V dc at less than 50 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: one current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	250mA maximum each output up to 50°C, derated to 150 mA at 70°C (derate 5 mA/°C) **Off-state leakage** current less than 1 microamp **Output saturation voltage** (both outputs) less than 1 volt at 10mA and less than 2 volts at 250mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs
Output Response Time	Less than 2 milliseconds (NOTE: 1 second delay on power-up: outputs are non-conducting during this time)
Repeatability	0.5 milliseconds; response time and repeatability specifications are independent of signal strength
Adjustments	**Beneath sensor's transparent cover:** Light/Dark Operate select switch, and multi-turn sensitivity control on top of sensor, beneath a transparent o-ring sealed Lexan® cover, allows precise sensitivity setting (turn clockwise to increase gain). Optional logic and logic/display modules have adjustable timing functions.
Indicators	Indicator LEDs are highly visible, located beneath a raised transparent Lexan® dome on top of the sensor. **Power (green) LED** lights whenever 10 to 30V dc power is applied, and flashes to indicate output overload or output short circuit. A steady green LED also indicates that laser emission is "on" (laser light is being emitted). **Signal (red) AID™ system (US patent #4356393) LED** lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the strength of the received light signal **Load (yellow) LED** lights whenever an output is conducting **Optional 7-element LED** signal strength display module
Construction	Molded reinforced thermoplastic polyester housing, o-ring sealed transparent Lexan® cover, molded acrylic lenses, and stainless steel hardware. Q45s are designed to withstand 1200 psi washdown. The base of cabled models has a ½" NPS integral internal conduit thread.
Environmental Rating	NEMA 6P, IEC IP 67
Laser Classification	Class II laser product. US Safety Standards 21 CFR 1040.10 and 1040.11; European Standards EN 60825 and IEC 60825
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or 5-pin mini-style ("Q" suffix models), or 5-pin euro-style ("Q6" suffix models), quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 421 and Accessories section.
Operating Conditions	**Temperature:** -10° to +40°C (+14° to 104°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Optional logic timing modules are available. See page 422 for more information.
Certifications	CE ETL LISTED

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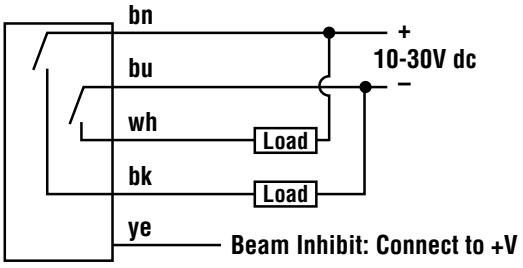
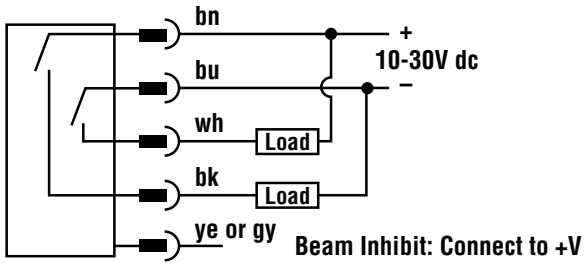
Q45BB6 Retroreflective Laser Series DC Hookup Diagrams

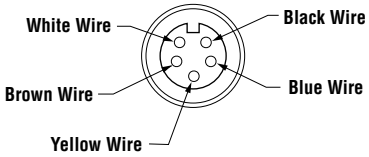
Retro Laser Sensors with Attached Cable



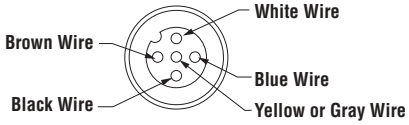
Retro Laser Sensors with Quick-Disconnect



5-Pin Mini-Style Pin-out



5-Pin Euro-Style Pin-out



Quick-Disconnect (QD) Option

DC Q45BB6 Retro Laser Series sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 5-pin Mini-style or Euro-style QD cable fitting.

DC 5-pin Mini-style QD sensors are identified by the letter “Q” in their model number suffix. 5-pin Euro-style QD sensors are identified by the letter “Q6” in their model number suffix. Mating cables for QD Q45BB6 Retro Laser sensors are specified on page 421 and in the Accessories section.

Q45VR2 Series AC Specifications

Supply Voltage and Current	90 to 250V ac (50 - 60 Hz). Average current 20 mA. Peak current 500 mA at 120V ac, 750 mA at 250V ac.
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	SPDT (single-pole double-throw) electromechanical relay output
Output Rating	**Max. switching power (resistive load):** 150W, 600 VA **Max. switching voltage (resistive load):** 250V ac or 30V dc **Max. switching current (resistive load):** 5A **Min. voltage and current:** 5V dc, 0.1A **Mechanical life of relay:** 10,000,000 operations **Electrical life of relay at full resistive load:** 100,000 operations
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	15 milliseconds ON and OFF (NOTE: 100 millisecond delay on power-up. Output is de-energized during this time.)
Repeatability	**Opposed mode:** 0.25 milliseconds; **All sensing modes:** 0.5 milliseconds Response time and repeatability specifications are independent of signal strength.
Adjustments	**Beneath sensor's transparent cover:** Light/Dark Operate select switch, and multi-turn sensitivity control on top of sensor, beneath a transparent o-ring sealed Lexan® cover, allows precise sensitivity setting (turn clockwise to increase gain). Optional logic and logic/display modules have adjustable timing functions.
Indicators	Indicator LEDs are highly visible, located beneath a raised transparent Lexan® dome on top of the sensor. **Power (green) LED** lights whenever 90-250V ac power is applied **Signal (red) AID™ system LED** lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the strength of the received light signal **Load (yellow) LED** lights whenever an output relay is energized **Optional 7-element LED** signal strength display module
Construction	Molded reinforced thermoplastic polyester housing, o-ring sealed transparent Lexan® cover, molded acrylic lenses, and stainless steel hardware. Q45s are designed to withstand 1200 psi washdown. The base of cabled models has a ½" NPS integral internal conduit thread.
Environmental Rating	NEMA 6P, IEC IP67
Connections	PVC-jacketed 2-wire emitters or 5-wire (all others) 2m (6.5') or 9 m (30') unterminated cables, or 3-pin (emitters) or 5-pin (all others) Mini-style quick-disconnect (QD) fittings are available ("Q"- suffix models). QD cables are ordered separately. See page 421 and Accessories section.
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Transient suppression is recommended for contacts switching inductive loads. Optional logic timing modules are available. See page 422 for more information.
Certifications	CE CSA® UL LISTED

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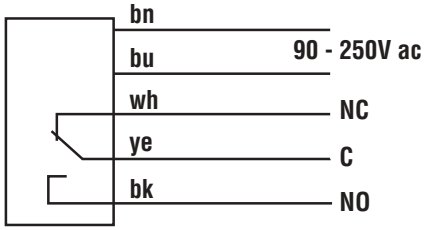
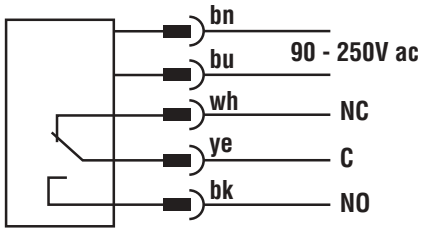
Q45VR2 Series AC Hookup Diagrams

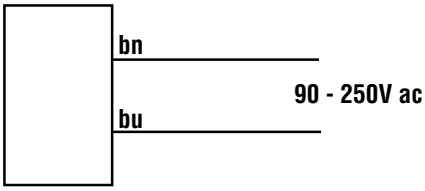
Q45VR2 Sensors with Attached Cable



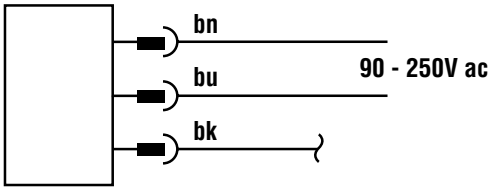
Q45VR2 Sensors with Quick-Disconnect 5-Pin Mini-Style (model suffix Q)



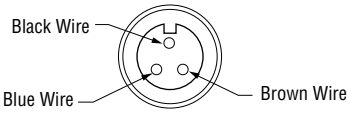
Q452E Emitters with Attached Cable



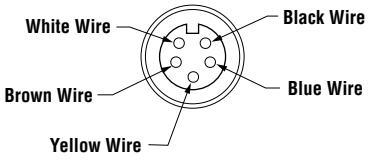
Q452EQ Emitters with Quick-Disconnect 3-Pin Mini-Style



Q452EQ Emitter 3-Pin Mini-Style Pin-out (Cable Connector Shown)



"Q" Model Suffix 5-Pin Mini-Style Pin-out (Cable Connector Shown)



Quick-Disconnect (QD) Option

AC Q45VR2 Series sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 3-pin Mini-style (opposed mode emitter) or 5-pin Mini-style QD (all others) cable fitting.

Mini-style QD sensors are identified by the letter "Q" in their model number suffix. Mating cables for QD Q45VR2 sensors are specified on page 421 and in the Accessories section. Cables are supplied in a standard length of 4 m (12').

Q45BW22 Series AC Specifications

Supply Voltage and Current	90 to 250V ac (50 - 60 Hz). Average current 20 mA. Peak current 500 mA at 120V ac, 750 mA at 250V ac.
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	Short circuit/overload protected FET solid-state relay
Output Rating	**Continuous current** 300 mA max. to 50°C (derate to 200 mA at 70°C, 5 mA/°C) **Inrush current** 3A max. for 100 milliseconds, 5A max. for 1 millisecond **Off-state leakage current** <100 microamps **Saturation voltage** <3V at 300 mA
Output Protection Circuitry	Manually-resettable output latch-out trips in the event of an output overload or short circuit condition. The green Power LED flashes to indicate the latch-out. To reset the output, remove power to the sensor and load for 5 seconds, then restore power.
Output Response Time	**Opposed mode:** 2 milliseconds ON, 1 millisecond OFF **All other sensing modes:** 2 milliseconds ON/OFF (NOTE: 100 millisecond delay on power-up. Output is non-conducting during this time.)
Repeatability	**Opposed mode:** 0.25 milliseconds; **All sensing modes:** 0.5 milliseconds Response time and repeatability specifications are independent of signal strength.
Adjustments	**Beneath sensor's transparent cover:** Light/Dark Operate select switch, and multi-turn sensitivity control on top of sensor, beneath a transparent o-ring sealed Lexan® cover, allows precise sensitivity setting (turn clockwise to increase gain). Optional logic and logic/display modules have adjustable timing functions.
Indicators	Indicator LEDs are highly visible, located beneath a raised transparent Lexan® dome on top of the sensor. **Power (green) LED lights whenever 90 - 250V ac power is applied, and flashes to indicate output overload** or output short circuit **Signal (red) AID™ system LED** lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the strength of the received light signal **Load (yellow) LED** lights whenever the output is conducting **Optional 7-element LED** signal strength display module
Construction	Molded reinforced thermoplastic polyester housing, o-ring sealed transparent Lexan® cover, molded acrylic lenses, and stainless steel hardware. Q45s are designed to withstand 1200 psi washdown. The base of cabled models has a ½" NPS integral internal conduit thread.
Environmental Rating	NEMA 6P, IEC IP67
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or 3-pin Mini-style ("Q" suffix models) or 4-pin Micro-style ("Q1" suffix models) quick-disconnect (QD) fittings are available. QD cables are ordered separately. See page 421 and Accessories section.
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Optional logic timing modules are available. See page 422 for more information.
Certifications	CE, CSA®, UL LISTED

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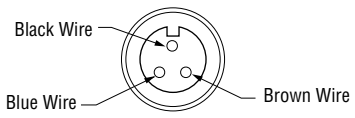
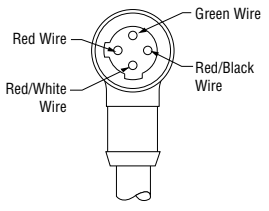
3-Pin Mini-Style Pin-out
(Cable Connector Shown)

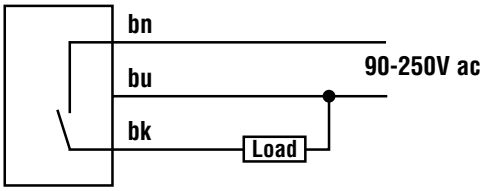


4-Pin Micro-Style Pin-out
(Cable Connector Shown)

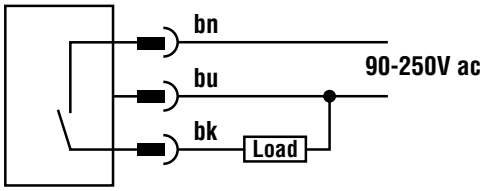


Q45BW22 Series AC Hookup Diagrams

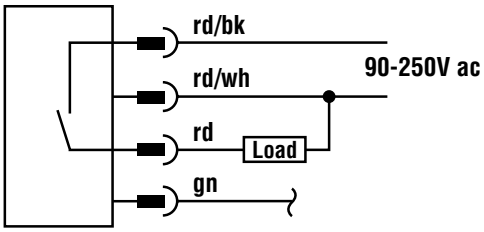
Q45BW22 Sensors with Attached Cable



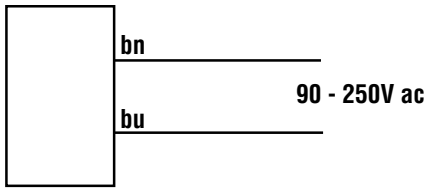
Q45BW22 Sensors with Quick-Disconnect 3-Pin Mini-Style (Model suffix Q)



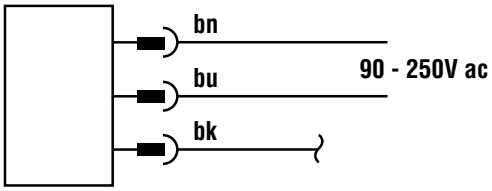
Q45BW22 Sensors with Quick-Disconnect 4-Pin Micro-Style (Model suffix Q1)



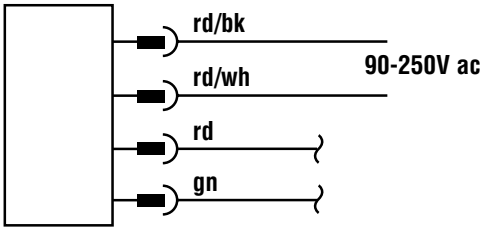
Q452E Emitter with Attached Cable



Q452EQ Emitter with Quick-Disconnect 3-Pin Mini-Style



Q452EQ1 Emitter with Quick-Disconnect 4-Pin Micro-Style



Quick-Disconnect (QD) Option

AC Q45BW22 Series sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 3-pin Mini-style or 4-pin Micro-style QD cable fitting.

AC 3-pin mini-style QD sensors are identified by the letter “Q” in their model number suffix and 4-pin Micro-style are identified by the letters “Q1”. Mating cables for QD Q45BW22 sensors are specified on page 421 and in the Accessories section.

Q45VR3 Series Specifications

Supply Voltage and Current	Universal voltage: 24 to 250V ac, 50/60 Hz or 12 to 250V dc (1.5 watts maximum)
Supply Protection Circuitry	Protected against transient voltages. DC hookup is without regard to polarity.
Output Configuration	SPDT (Single-Pole, Double-Throw) electromechanical relay output. All models except emitters.
Output Rating	**Max. switching power (resistive load):** 1250VA, 150W **Max. switching voltage (resistive load):** 250V ac, 125V dc **Max. switching current (resistive load):** 5A @ 250V ac, 5A @ 30V dc derated to 200 mA @ 125V dc **Min. voltage and current:** 5V dc, 10mA **Mechanical life of relay:** 50,000,000 operations **Electrical life of relay at full resistive load:** 100,000 operations
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	15 milliseconds ON and OFF (NOTE: 100 millisecond delay on power-up. Relay is de-energized during this time.)
Repeatability	**Opposed mode:** 0.25 milliseconds **All other sensing modes:** 0.5 milliseconds Response time and repeatability specifications are independent of signal strength.
Adjustments	**Beneath sensor's transparent cover:** Light/Dark Operate select switch; and multi-turn Sensitivity control on top of sensor beneath a transparent o-ring-sealed Lexan® cover, allows precise sensitivity setting (turn clockwise to increase gain). Optional logic and logic/display modules have adjustable timing functions (see page 10).
Indicators	Indicator LEDs are clearly visible beneath a raised transparent Lexan® dome on top of the sensor. **Power (green) LED** lights whenever 24 to 250V ac, or 12 to 250V dc power is applied **Signal (red) AID™ System LED** lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the strength of the received light signal **Load (yellow) LED** lights whenever the output relay is energized Optional 7-element LED signal strength display module
Construction	Molded reinforced thermoplastic polyester housing, o-ring-sealed transparent Lexan® cover, molded acrylic lenses, and stainless steel hardware. Q45s are designed to withstand 1200 psi washdown. The base of cabled models has a ½" NPS integral internal conduit thread.
Environmental Rating	NEMA 6P, IEC IP67
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') unterminated cables, or 5-pin mini-style quick-disconnect (QD) fittings are available ("Q"- suffix models). QD cables are ordered separately. See page 421 and Accessories section.
Operating Conditions	**Temperature:** -25° to +55° C (-13° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Transient suppression is recommended for contacts switching inductive loads. Optional output timing modules are available. See page 422 for more information.
Certifications	CE CSA® UL LISTED

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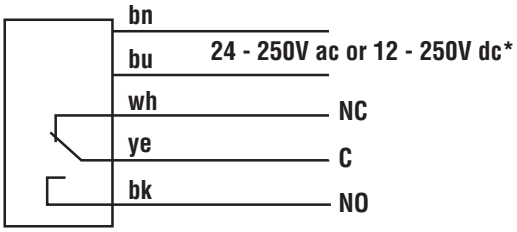
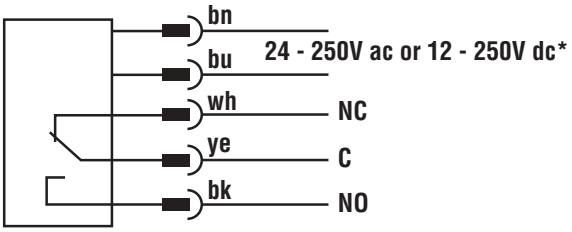
Q45VR3 Series Hookup Diagrams

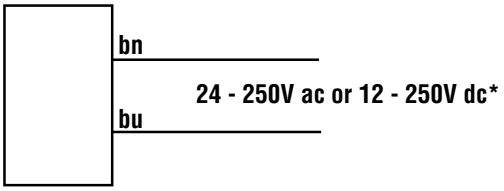
Q45VR3 Sensors with Attached Cable



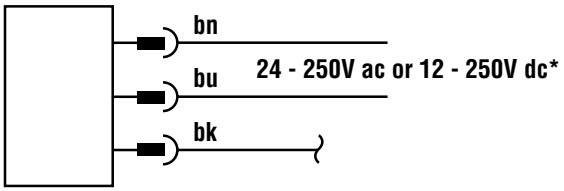
Q45VR3 Sensors with Quick-Disconnect 5-Pin Mini-Style (model suffix Q)



Q453E Emitters with Attached Cable

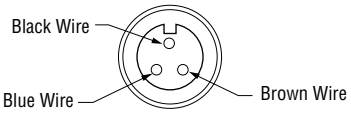


Q453EQ Emitters with Quick-Disconnect 3-Pin Mini-Style

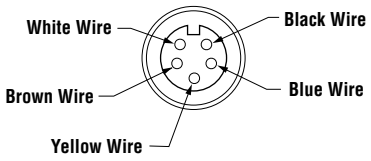


*NOTE: Connection of dc power is without regard to polarity.

Q453EQ Emitter 3-Pin Mini-Style Pin-out (Cable Connector Shown)



"Q" Model Suffix 5-Pin Mini-Style Pin-out (Cable Connector Shown)



Quick-Disconnect (QD) Option

AC Q45VR3 Series sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 3-pin Mini-style (opposed mode emitter) or 5-pin Mini-style Quick-Disconnect (QD) cable fitting.

Mini-style QD sensors are identified by the suffix "Q" in their model number suffix. Mating cables for QD Q45VR3 sensors are specified on page 421 and in the Accessories section.

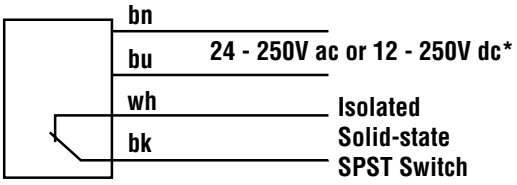
Q45BW13 Series Specifications

Supply Voltage and Current	Universal voltage: 24 to 250V ac, 50/60 Hz or 12 to 250V dc (1.5 watts maximum)
Supply Protection Circuitry	Protected against transient voltages. DC hookup is without regard to polarity.
Output Configuration	**All models except emitters:** Optically isolated SPST solid-state switch
Output Rating	250V ac, 250V dc, 300 mA **Output saturation voltage:** 3V at 300 mA, 2V at 15 mA **Off-state leakage current:** <50 microamps **Inrush current:** 1 amp for 20 milliseconds, non-repetitive
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	**Opposed mode:** 2 milliseconds on, 1 millisecond off **All other sensing modes:** 2 milliseconds on/off (NOTE: 100 millisecond delay on power-up. Output is non-conducting during this time.)
Repeatability	**Opposed mode:** 0.25 milliseconds **All other sensing modes:** 0.5 milliseconds Response time and repeatability specifications are independent of signal strength.
Adjustments	**Beneath sensor's transparent cover:** Light/Dark Operate select switch; and multi-turn Sensitivity control on top of sensor beneath a transparent o-ring-sealed Lexan® cover, allows precise sensitivity setting (turn clockwise to increase gain). Optional logic and logic/display modules have adjustable timing functions (see page 148).
Indicators	Indicator LEDs are clearly visible beneath a raised transparent Lexan® dome on top of the sensor. **Power (green) LED** lights whenever 24 to 250V ac, or 12 to 250V dc power is applied **Signal (red) AID™ System LED** lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the strength of the received light signal **Load (yellow) LED** lights whenever the output relay is energized **Optional 7-element LED** signal strength display module
Construction	Molded reinforced thermoplastic polyester housing, o-ring-sealed transparent Lexan® cover, molded acrylic lenses, and stainless steel hardware. Q45s are designed to withstand 1200 psi washdown. The base of cabled models has a ½" NPS integral internal conduit thread.
Environmental Rating	NEMA 6P, IEC IP67
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') unterminated cables, or 4-pin mini-style quick-disconnect (QD) fittings are available ("Q"- suffix models). QD cables are ordered separately. See page 421 and Accessories section.
Operating Conditions	**Temperature:** -25° to +55° C (-13° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Optional output timing modules are available. See page 422 for more information. Output is not short-circuit protected. Exercise care when making wiring connections.
Certifications	UL LISTED

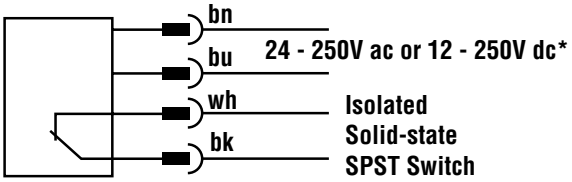
Lexan® is a registered trademark of General Electric Co.

Q45BW13 Series Hookup Diagrams

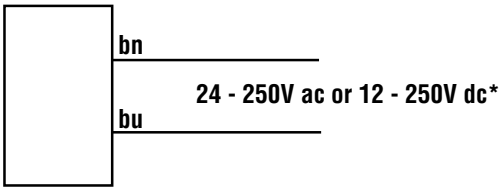
Q45BW13 Sensors with Attached Cable



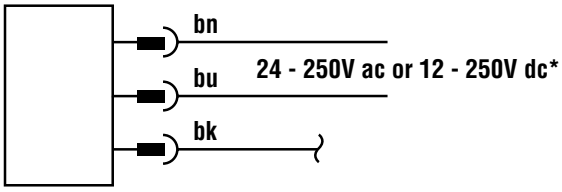
Q45BW13 Sensors with Quick-Disconnect 4-Pin Mini-Style (model suffix Q)



Q453E Emitter with Attached Cable

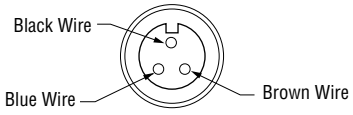


Q453EQ Emitter with Quick-Disconnect 3-Pin Mini-Style

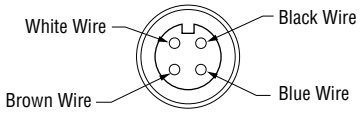


*NOTE: Connection of dc power is without regard to polarity.

Q453EQ Emitter 3-Pin Mini-Style Pin-out (Cable Connector Shown)



"Q" Model Suffix 4-Pin Mini-Style Pin-out (Cable Connector Shown)



Quick-Disconnect (QD) Option

AC Q45BW13 Series sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 3-pin Mini-style (opposed mode emitter) or 4-pin Mini-style Quick-Disconnect (QD) cable fitting.

Mini-style QD sensors are identified by the suffix "Q" in their model number suffix. Mating cables for QD Q45BW13 sensors are specified on page 421 and in the Accessories section.

Q45X Series Sensors for Device Level Bus Networks

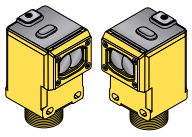
for Use with Bus Expansion Cards *(see page 405)*

Q45X Series diffuse mode sensor shown. At right, a plug-in expansion card.

- Easy "smart sensor" interfacing to a device level data bus network by simply selecting the appropriate plug-in card and cable for popular bus protocols, including DeviceNet™, SDS™, and ASI™
- Expansion cards for other bus network protocols are possible – contact factory

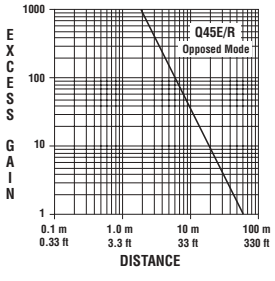
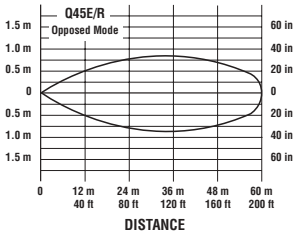
  Sensor wiring is accomplished using simple "dumb drop" junction boxes or "T" connectors
- Integral mini-style quick-disconnect (QD) connector

Q45X Series Sensing Mode Options



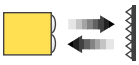
Infrared, 880 nm

Q45X Opposed Mode Emitter (E) and Receiver (R)

Models	Focus	Cable	Supply Voltage	Excess Gain	Beam Pattern
Q45X6EQ **Q45XB6RQ**	60 m (200')	5-pin Mini QD	Depends on Bus Expansion Card Used (see page 405)		Effective Beam: 13 mm 

For Q45Xs:

i) Sensors require a mini-style quick-disconnect cable. Contact your Banner sales engineer for help with cable selection.

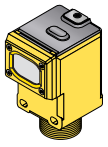


Visible red, 680 nm

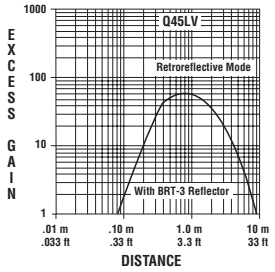
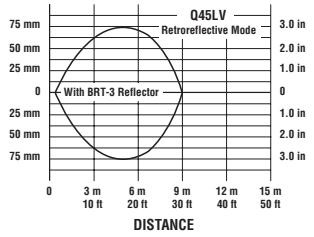
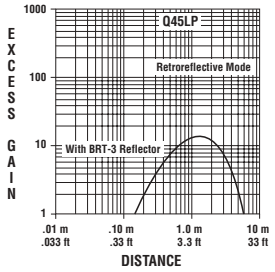
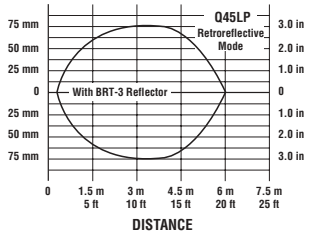
Non-Polarized

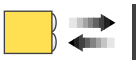
Polarized

NOTE: Use polarized models when shiny objects will be sensed. Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

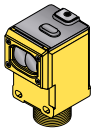


Q45X Retroreflective Mode

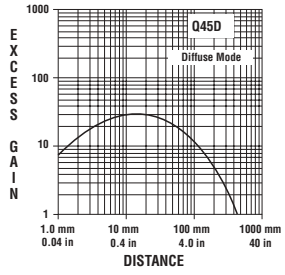
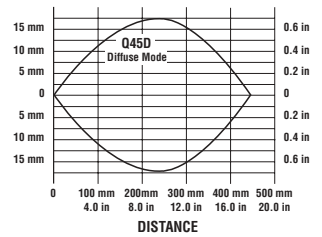
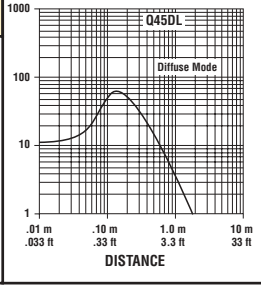
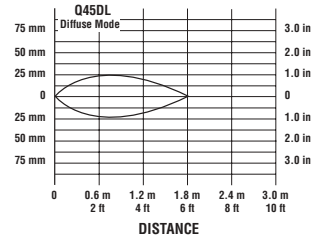
Models	Focus	Cable	Supply Voltage	Excess Gain	Beam Pattern
Non-Polarized					
Q45XB6LVQ	.08 m to 9 m (3" to 30')	5-pin Mini QD	Depends on Bus Expansion Card Used (see page 405)		
Polarized					
Q45XB6LPQ	.15 m to 6 m (6" to 20')	5-pin Mini QD	Depends on Bus Expansion Card Used (see page 405)		

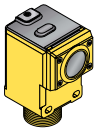


Infrared, 880 nm



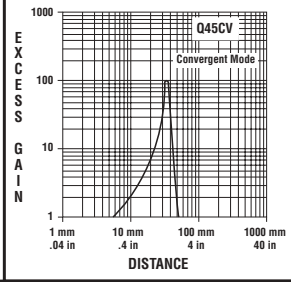
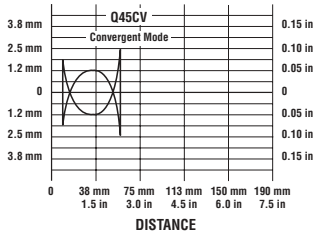
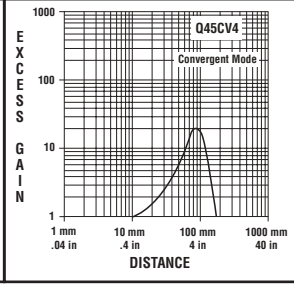
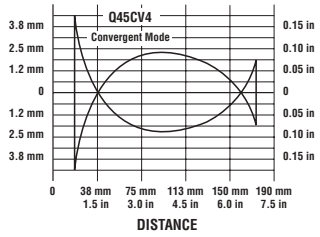
Q45X Diffuse Mode

Models	Focus	Cable	Supply Voltage	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
Short Range Diffuse					
Q45XB6DQ	450 mm (18")	5-pin Mini QD	Depends on Bus Expansion Card Used (see page 405)		
Long Range Diffuse					
Q45XB6DLQ	1.8 m (6')	5-pin Mini QD	Depends on Bus Expansion Card Used (see page 405)		



Visible red, 680 nm

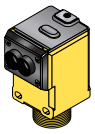
Q45X Convergent Mode

Models	Focus	Cable	Supply Voltage	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
Q45XB6CVQ	38 mm (1.5") Spot Size at Focus: 1.3 mm (0.05")	5-pin Mini QD	Depends on Bus Expansion Card Used (see page 405)		
Q45XB6CV4Q	100 mm (4") Spot Size at Focus: 1.3 mm (0.05")	5-pin Mini QD	Depends on Bus Expansion Card Used (see page 405)		

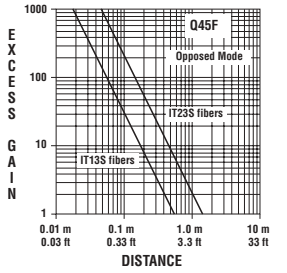
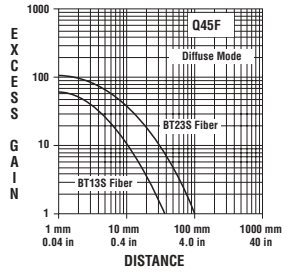
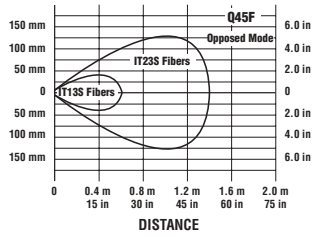
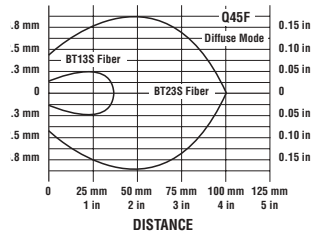
For Q45Xs:

i) Sensors require a mini-style quick-disconnect cable. Contact your Banner sales engineer for help with cable selection.

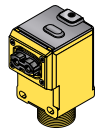
Infrared, 880 nm



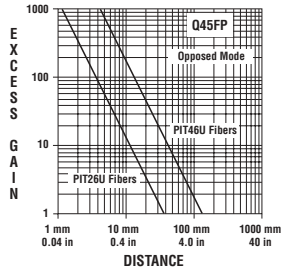
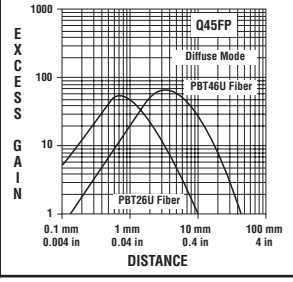
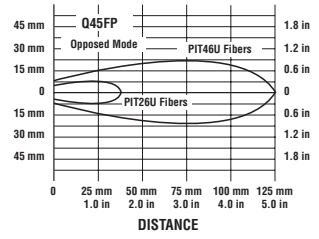
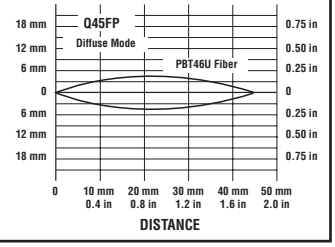
Q45X Glass Fiber Optic Mode

Models	Focus	Cable	Supply Voltage	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
Q45XB6FQ	Range varies by sensing mode and fiber optics used	5-pin Mini QD	Depends on Bus Expansion Card Used (see page 405)	 	 

Visible red, 660 nm



Q45X Plastic Fiber Optic Mode

Models	Focus	Cable	Supply Voltage	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
Q45XB6FPQ	Range varies by sensing mode and fiber optics used	5-pin Mini QD	Depends on Bus Expansion Card Used (see page 405)	 	 

Q45X Specifications

Supply Voltage and Current	The sensor is powered by the bus network (depends on Bus Expansion Card used, see page 405)
Supply Protection Circuitry	Protected against reverse polarity, transient voltages, and loss of ground. (none of these conditions will harm the sensor or interrupt communication on the network)
Response Time	2 milliseconds; Total response time will also include the response time of the network
Adjustments	Multi-turn SENSITIVITY control on top of the sensor (beneath a transparent o-ring sealed cover) allows precise sensitivity setting (turn clockwise to increase gain); Internal switch must be in Light Operate (L/O) position, which is the factory setting
Indicators	**On the sensor:** Green and Red; visible through the transparent sensor top cover **Green LED** lights for dc power "ON" **Red LED** is Banner's patented Alignment Indicating Device (AID™, U.S. patent #4356393) which lights whenever the sensor "sees" a light condition and superimposes a pulse rate which is proportional to the strength of the received light signal (the stronger the signal, the faster the pulse rate) **Emitter model Q45X6EQ has green power indicator, only.** **Also see expansion card specifications for description of additional indicators.**
Construction	Molded thermoplastic polyester housing; Molded acrylic lenses; Stainless steel hardware. O-ring sealed transparent Lexan® top cover
Environmental Rating	IEC IP67; NEMA 6P
Connections	Mini-style quick-disconnect cables specific to protocol required; contact your Banner sales engineer or Interlink BT for cable information.
Operating Conditions	**Temperature:** See specifications for expansion cards **Relative humidity:** 95% (non-condensing)
Certifications	CE cSAus NRTL/C

Lexan® is a registered trademark of General Electric Co.

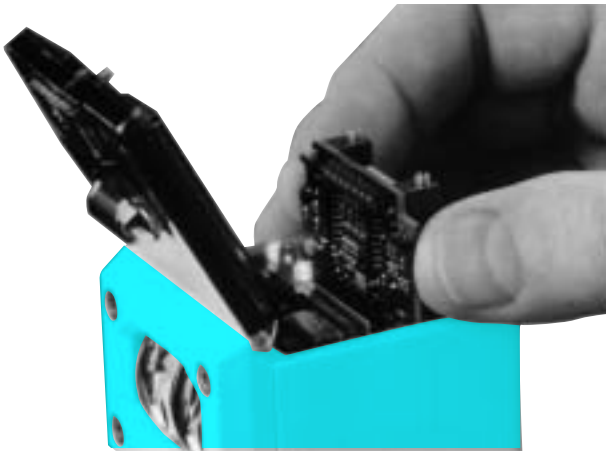
Bus Expansion Cards

for Use with Q45X Series Photoelectric Sensors

Banner Bus Network plug-in bus cards enable a Banner Q45X Series sensor to establish a logical relationship between the sensor's output and other compatible devices on a specific bus network. Use of a bus expansion card turns the Q45X into a "smart" sensor which can be connected to a specific bus network such as DeviceNet™, SDS™ and AS-Interface protocols, using a simple "dumb drop" junction box or a "T" connector. Plugging a bus expansion card into a Q45X Series sensor automatically converts the basic sensor outputs to a pair of datacom connections with the proper protocol for use on a specific bus network.

Select a bus expansion card for the bus network protocol required. Banner has the following bus expansion cards available. Other expansion cards are available for protocols not mentioned here. Please contact Banner's Applications Department.

The Q45X sensor with any expansion card installed, requires protocol compatible quick-disconnect cables. Contact your Banner sales engineer for cable information.

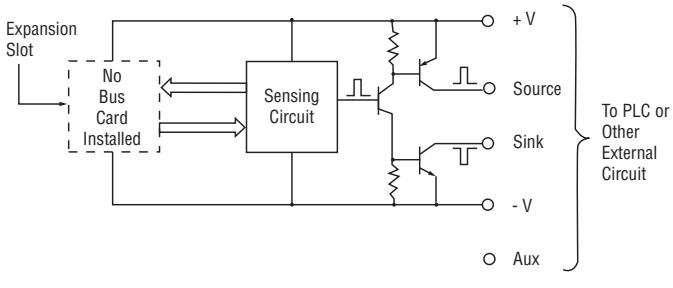


Bus Network Expansion Cards

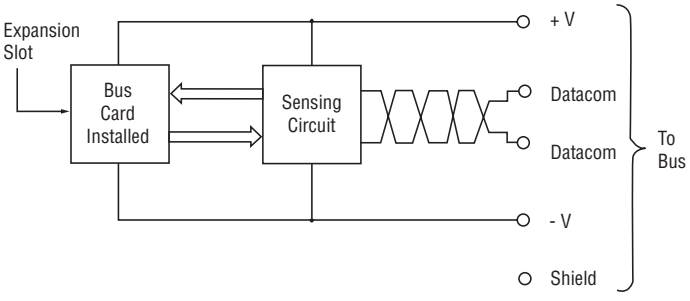
Models	Used with Sensor	Sensor Bus Protocol
45DN1 Bit Strobe	All Q45X models, except emitter	DeviceNet™
45DN2 Change of State		
45DNE1	Q45X6EQ Emitter	
45AS1	All Q45X models, except emitter	AS-Interface
45ASE1	Q45X6EQ Emitter	
45SD1	Any Q45X sensor	SDS™

Q45X Sensor Functional Schematic

Basic Configuration with Bus Card NOT Installed



Basic Configuration with Bus Card Installed

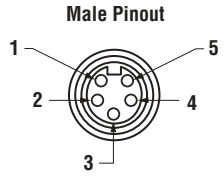


Bus Expansion Card Specifications

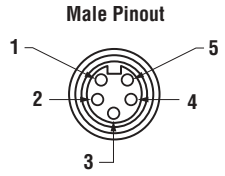
Supply Voltage and Current	Q45DN Cards: 11 to 25V dc @ 60 mA Q45AS Cards: 18 to 33V dc @ 45 mA Q45SD1 Card: 11 to 25V dc @ 60 mA
Supply Protection Circuitry	Protected against reverse polarity, transient voltages and loss of ground (none of these conditions will harm the sensor or interrupt communication on the network)
Response Time	2 milliseconds; total response time will also include the response time of the network
Indicators	**On the sensor:** Green and Red; visible through the transparent sensor top cover **Green LED** lights for dc power "ON" **Red LED(except emitter model Q45X6EQ)** is Banner's patented Alignment Indicating Device (AID™, U.S. patent #4356393) which lights whenever the sensor "sees" a light condition and superimposes a pulse rate which is proportional to the strength of the received light signal (the stronger the signal, the faster the pulse rate) **On the Q45DN1 and Q45DN2 Bus Cards**: Green and Red; visible through the transparent sensor top cover A bi-color LED indicates the status of the network. **Green** Steady — Sensor on line, connected to master Flashing — Sensor on line - address + baud rate are ok **Red** Steady — Critical network fault or duplicate node address detected; wrong baud rate Flashing — Minor or connection time-out fault **On the Q45SD1** Bus Card (visible through the transparent sensor top cover): A bi-color LED indicates the status of the network. Green — Sensor communicating Red — Critical fault
Operating Conditions	**Temperature:** Q45DN Cards: -10° to +70°C (-14° to +158°F) Q45AS Cards: -25° to +70°C (-13° to +158°F) Q45SD1 Card: -20° to +50°C (-4° to +122°F) **Relative humidity for all cards:** 95% (non-condensing)

Q45X Hookup Information

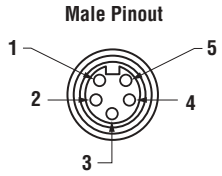
45DN Bus Expansion Card Hookup

Q45X Male Connector	Pin	Wire Color	Function
	1		Shield
	2	Red	BUS power (+V)
	3	Black	BUS power (-V)
	4	White	Communications +
	5	Blue	Communications -

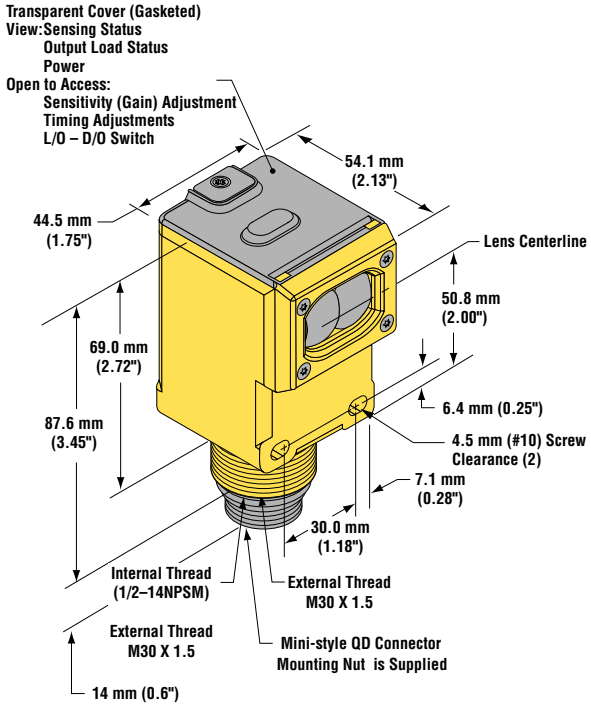
Q45X Hookup Information

45AS Bus Expansion Card Hookup			
Q45X Male Connector	Pin	Wire Color	Function
	1		No Connection*
	2		No Connection*
	3		No Connection*
	4	Blue	AS-Interface +
	5	Brown	AS-Interface -

*Pins #1, 2 and 3 should be left floating for proper operation

45SD1 Bus Expansion Card Hookup			
Q45X Male Connector	Pin	Wire Color	Function
	1		Shield
	2	Brown	BUS power (+V)
	3	Blue	BUS power (-V)
	4	Black	Communications +
	5	White	Communications -

Q45X Dimensions



Q45XDN Sensors for Bus Networks

with Protocol-specific Expansion Card Installed

- Q45XDN Series sensors interface to DeviceNet™ bus networks
- These “smart” sensors can be wired to a DeviceNet bus network using simple “dump drop” junction boxes or “T” connectors
- Each model has integral 12 mm euro-style quick-disconnect connector for DeviceNet cable

Q45XDN Series Sensing Mode Options

Q45XDN DeviceNet™ Sensors

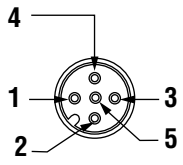
Models	Sensing Mode	Focus	Cable	Supply Voltage	I/O Support	Excess Gain	Beam Pattern
Q45XDN1EQ6	Opposed Emitter	60 m (200')	DeviceNet 5-pin Euro QD	18-33V dc	Emitter Only	Excess gain curves and beam patterns are the same for all Q45X models. See respective sensor mode charts starting on page 400.	
Q45XDN1RQ6	Opposed Receiver				Bit Strobe		
Q45XDN2RQ6	Opposed Receiver				Change of State		
Q45XDN1LVQ6	Retro, Non-polarized	.08 m - 9 m (3" - 30')			Bit Strobe		
Q45XDN2LVQ6					Change of State		
Q45XDN1LPQ6	Retro, Polarized	.15 m - 6 m (6" - 20')			Bit Strobe		
Q45XDN2LPQ6					Change of State		
Q45XDN1DQ6	Diffuse, Short-range	450 mm (18")			Bit Strobe		
Q45XDN2DQ6					Change of State		
Q45XDN1DLQ6	Diffuse, Long-range	1.8 m (6')			Bit Strobe		
Q45XDN2DLQ6					Change of State		
Q45XDN1CVQ6	Convergent	38 mm (1.5")			Bit Strobe		
Q45XDN2CVQ6					Change of State		
Q45XDN1CV4Q6		100 mm (4")			Bit Strobe		
Q45XDN2CV4Q6					Change of State		
Q45XDN1FQ6	Glass Fiber Optic	Range varies by sensing mode and fiber optics used			Bit Strobe		
Q45XDN2FQ6					Change of State		
Q45XDN1FPQ6	Glass Fiber Optic				Bit Strobe		
Q45XDN2FPQ6					Change of State		

Q45XDN Specifications

Supply Voltage and Current	The sensor is powered by the bus network: 11 to 25V dc @ 60 mA
Supply Protection Circuitry	Protected against reverse polarity, transient voltages, and loss of ground. (none of these conditions will harm the sensor or interrupt communication on the network)
Response Time	2 milliseconds; Total response time will also include the response time of the network
Adjustments	Multi-turn SENSITIVITY control on top of the sensor (beneath a transparent o-ring sealed cover) allows precise sensitivity setting (turn clockwise to increase gain); Internal switch must be in Light Operate (L/O) position, which is the factory setting
Indicators	**On the sensor:** Green and Red; visible through the transparent sensor top cover **Green LED** lights for dc power "ON" **Red LED** is Banner's patented Alignment Indicating Device (AID™, U.S. patent #4356393) which lights whenever the sensor "sees" a light condition and superimposes a pulse rate which is proportional to the strength of the received light signal (the stronger the signal, the faster the pulse rate) **On the Q45DN** Bus Card: Green and Red; visible through the transparent sensor top cover A bi-color LED indicates the status of the network. **Green** Steady — Sensor on line, connected to master Flashing — Sensor on line - address + baud rate are ok **Red** Steady — Critical network fault or duplicate node address detected; wrong baud rate Flashing — Minor or connection time-out fault
Sensor Configuration	The following features of the Q45XDN Series sensors are programmable via the network with a configuration tool: **Feature** — **Range** Network Address — 0-63 Baud Rate — 125 K, 250 K, 500 K Operation Mode — LIght Operate or Dark Operate All Q45XDN models support: **Explicit Message Connection:** Required to *Set* and *Get* sensor Attributes Q45XDN1 models support: **Bit Strobe Connection:** Responds to a master's request Q45XDN2 models support: **Change of State Connection:** which responds to a slave's change of state I/O Response is with the following 8-bit word of data: Bit 0: 0 Output is "OFF"; 1 Output is "ON" Bit 1: 0 Alarm output is "OFF"; 1 Alarm output is "ON" Bit 2-7: Not Used: Always 0 Notes: Configuration may be simplified through use of an Electronic Data Sheet (Banner model EDS 40223)
Construction	Molded thermoplastic polyester housing; Molded acrylic lenses; Stainless steel hardware. O-ring sealed transparent Lexan® top cover
Environmental Rating	IEC IP67; NEMA 6P
Connections	Euro-style DeviceNet™ quick-disconnect cables are ordered separately; contact your Banner sales engineer or Interlink BT for cable information.
Operating Conditions	**Temperature:** -25° to +70°C (-13° to +158°F) **Relative humidity:** 95% (non-condensing)

Lexan® is a registered trademark of General Electric Co.

Q45XDN Hookup Information

Q45XDN DeviceNet™ Hookup			
Q45X Male Connector	**Pin**	**Wire Color**	**Function**
Male Pinout  	1		Shield
	2	Red	BUS power (+V)
	3	Black	BUS power (-V)
	4	White	Communications +
	5	Blue	Communications -

Q45XAS Sensors for AS-Interface Bus Networks

- Q45XAS Series sensors interface to AS-Interface bus networks
- These “smart” sensors can be wired to an ASI bus network using simple “dumb drop” junction boxes or “T” connectors
- Each model has an integral 12 mm euro-style quick-disconnect connect for protocol-compatible cable

Q45XAS Series Sensing Mode Options

Q45XAS AS-Interface Sensors

Models	Sensing Mode	Focus	Cable	Supply Voltage	Excess Gain	Beam Pattern
Q45XAS1EQ	Opposed Emitter	60 m (200')	ASI 4-pin Euro QD (see specifications)	18-33V dc	Excess gain curves and beam patterns are the same for all Q45X models. See respective sensor mode charts, starting on page 400.	
Q45XAS1RQ	Opposed Receiver					
Q45XAS1LVQ	Retro, Non-polarized	.08 m - 9 m (3" - 30')				
Q45XAS1LPQ	Retro, Polarized	.15 m - 6 m (6" - 20')				
Q45XAS1DQ	Diffuse, Short-range	450 mm (18")				
Q45XAS1DLQ	Diffuse, Long-range	1.8 m (6')				
Q45XAS1CVQ	Convergent	38 mm (1.5")				
Q45XAS1CV4Q		100 mm (4")				
Q45XAS1FQ	Glass Fiber Optic	Range varies by sensing mode and fiber optics used				
Q45XAS1FPQ	Plastic Fiber Optic					

Q45XAS Specifications

Supply Voltage and Current	The sensor is powered by the bus network: 18 to 33V dc @ 45 mA
Supply Protection Circuitry	Protected against reverse polarity, transient voltages, and loss of ground. (none of these conditions will harm the sensor or interrupt communication on the network)
Response Time	2 milliseconds; Total response time will also include the response time of the network
Adjustments	Multi-turn SENSITIVITY control on top of the sensor (beneath a transparent o-ring sealed cover) allows precise sensitivity setting (turn clockwise to increase gain); Internal switch must be in Light Operate (L/O) position, which is the factory setting
Indicators	Green and Red; visible through the transparent sensor top cover **Green LED** lights for dc power "ON" **Red LED** is Banner's patented Alignment Indicating Device (AID™, U.S. patent #4356393) which lights whenever the sensor "sees" a light condition and superimposes a pulse rate which is proportional to the strength of the received light signal (the stronger the signal, the faster the pulse rate)
Sensor Configuration	Q45XAS1 Series sensors conform to the following AS-Interface profile: S-1.1-4.2 Photoelectric Proximity Switches Per profile S1.1 the sensor's I/O code - 1, and the ID code = 1. The data and parameter bits that are supported are as follows:

Port	Type	Meaning	0 (Host)	1 (Host)
D0	Input	Sense	Dark	Light
D1	Input	Alarm	Warning	O.K.
D2	Input	N/A	N/A	N/A
D3	Output	Test	Emitter off	Normal
P0	Param.	Frequency	Low freq.	High freq.
P1	Param.	Invert DO	Invert DO	Normal
P2	Param.	Off-delay	20 ms	Normal
P3	Param.	N/A	N/A	N/A

Construction	Molded thermoplastic polyester housing; Molded acrylic lenses; Stainless steel hardware. O-ring sealed transparent Lexan® top cover
Environmental Rating	IEC IP67; NEMA 6P
Connections	Euro-style AS-Interface quick-disconnect cables are ordered separately; contact your Banner sales engineer or Interlink BT for cable information.
Operating Conditions	**Temperature:** -25° to +70°C (-13° to +158°F) **Relative humidity:** 95% (non-condensing)

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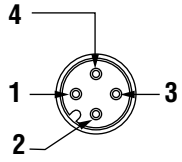
Q45XAS Hookup Information

Q45XAS1 AS-Interface Hookup

Q45X Male Connector	Pin	Wire Color	Function
Male Pinout  	1	Brown	AS-Interface +
	2		No Connection*
	3	Blue	AS-Interface -
	4		No Connection*

*Pins #2 and 4 should be left floating for proper operation

Q45XDN and Q45XAS Dimensions

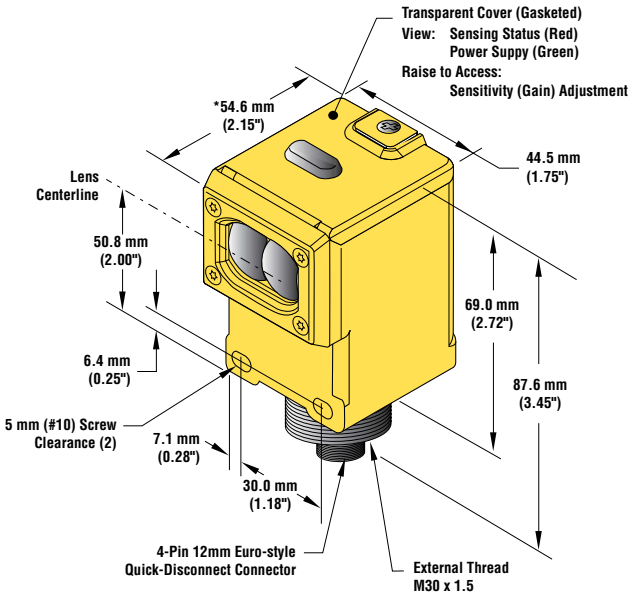
NOTES FOR DIMENSIONS

*54.6 mm (2.15") is the depth dimension for sensors with the following suffixes:
E (emitter), D (short-range diffuse), DL (long-range diffuse), LV (retroreflective), and R (receiver).

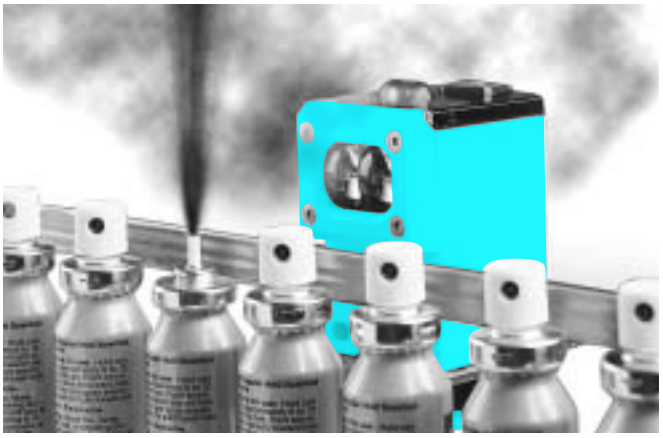
The sensor depth dimension for other models is as follows:
CV and CV4 (convergent): 61.5 mm (2.42")
LP (polarized retroreflective): 56.4 mm (2.30")
F (glass fiber optic): 60.5 mm (2.38")
FP (plastic fiber optic): 59.8 mm (2.35")

Emitters (“E” model suffix) have the green power status LED only, and no internal adjustments.

A 30 mm jam nut is supplied for mounting the sensor via its threaded base.

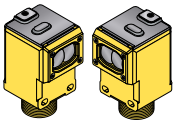


Q45 NAMUR Intrinsically Safe Sensors



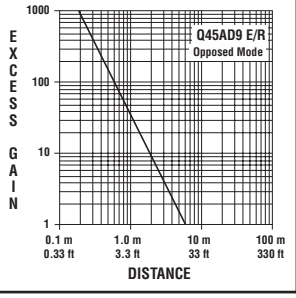
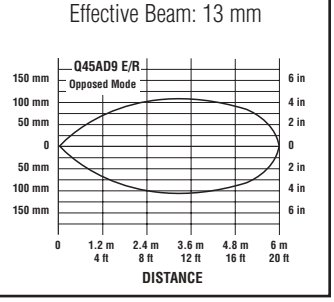
- Intrinsically safe sensors with the rugged design and exceptional optical performance of Q45 Series sensors
- Use with approved switching amplifiers which have intrinsically safe input circuits; designed in accordance with DIN 19 234
- Output passes ≤1.2 mA in the “dark” condition and ≥2.1 mA in the “light” condition
- Internal multi-turn SENSITIVITY (Gain) control accessible beneath hinged, o-ring sealed top cover
- Choose models with integral cable or quick-disconnect connector

Q45 NAMUR Sensing Mode Options



Infrared, 880 nm

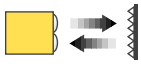
Q45 NAMUR Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Q459E **Q459EQ** **Q45AD9R** **Q45AD9RQ**	6 m (20')	2 m (6.5') 4-Pin Euro QD 2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		

For Q45 NAMUR Series Sensors:

i) 9 m (30') cables are available by adding suffix **“W/30”** to the model number of any cabled sensor (e.g. - **Q459E W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 421 and the Accessories section for more information.

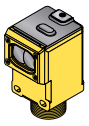


Visible red, 680 nm

Non-Polarized

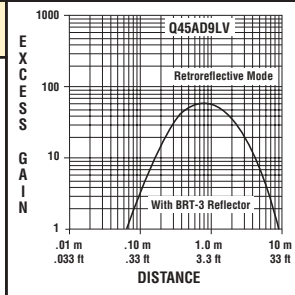
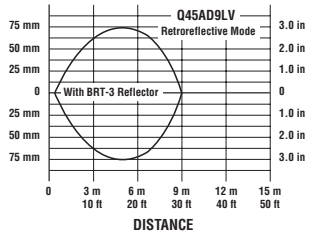
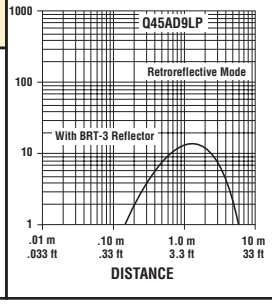
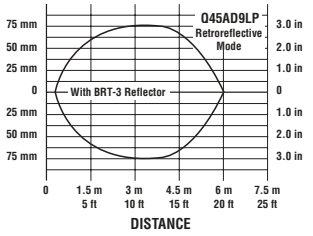
Polarized

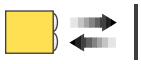
NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



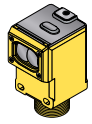
Non-Polarized, Polarized

Q45 NAMUR Retroreflective Mode

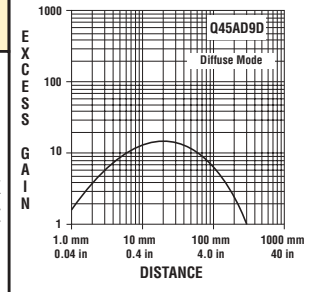
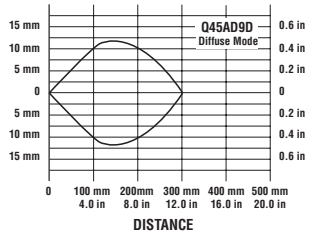
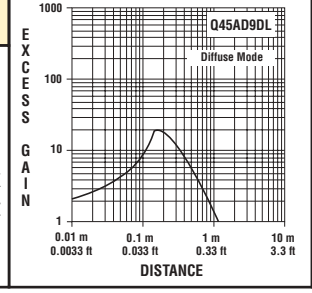
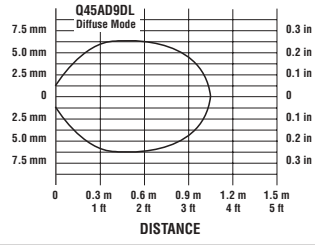
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
Non-Polarized						
Q45AD9LV **Q45AD9LVQ**	9 m (30')	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		
Polarized						
Q45AD9LP **Q45AD9LPQ**	6 m (20')	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		

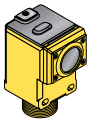


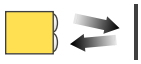
Infrared, 880 nm



Q45 NAMUR Diffuse Mode

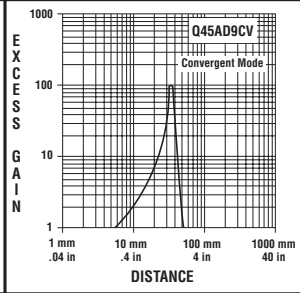
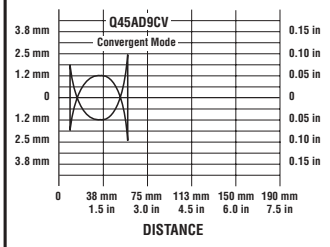
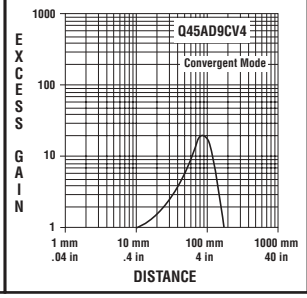
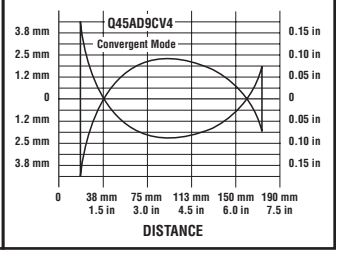
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Short Range						
Q45AD9D **Q45AD9DQ**	300 mm (12")	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		
Long Range						
Q45AD9DL **Q45AD9DLQ**	1 m (40")	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		

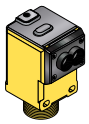




Visible red, 680 nm

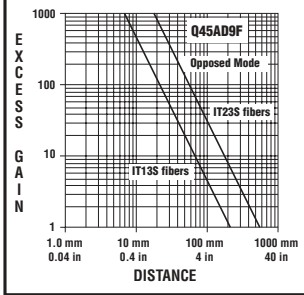
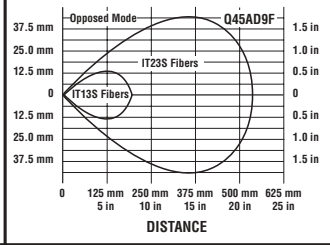
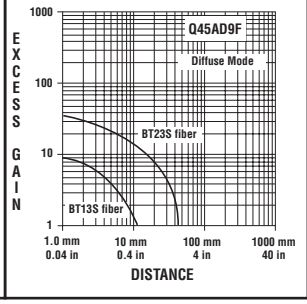
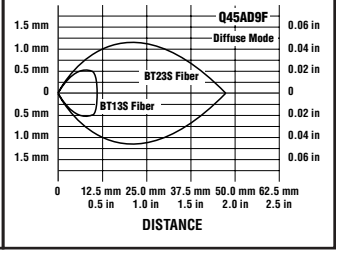
Q45 NAMUR Convergent Mode

Models	Focus	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Performance based on 90% reflectance white test card	
Q45AD9CV **Q45AD9CVQ**	38 mm (1.5") Spot Size at Focus: 1.3 mm (0.05")	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		
Q45AD9CV4 **Q45AD9CV4Q**	100 mm (4") Spot Size at Focus: 1.5 mm (0.06")	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		

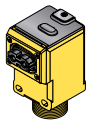


Infrared, 880 nm

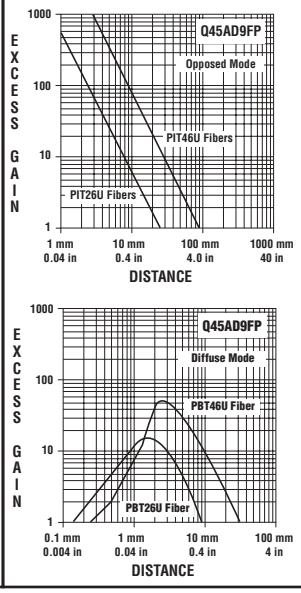
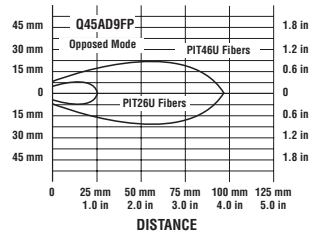
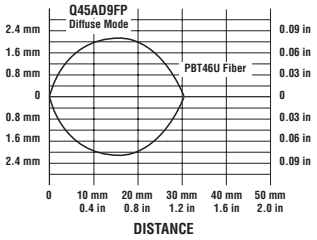
Q45 NAMUR Glass Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Q45AD9F **Q45AD9FQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light		
						

Visible red, 660 nm



Q45 NAMUR Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain	Beam Pattern
					Diffuse mode performance based on 90% reflectance white test card	
Q45AD9FP **Q45AD9FPQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Euro QD	5-15V dc	Constant Current ≤1.2 mA dark ≥2.1 mA light	 	 

For Q45 NAMUR Series Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **Q45AD9FP W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 421 and the Accessories section for more information.

Q45 NAMUR Specifications

Supply Voltage and Current	5 to 15V dc. Supply voltage is provided by the amplifier to which the sensor is connected.
Output	Constant current output: ≤1.2 mA in the "dark" condition and ≥2.1 mA in the "light" condition
Output Response Time	Opposed mode receiver: 2 milliseconds on/0.4 milliseconds off. All others 5 milliseconds on/off (does not include amplifier response)
Adjustments	Multi-turn sensitivity control on top of sensor, beneath a transparent o-ring sealed Lexan® cover, allows precise sensitivity setting (turn clockwise to increase gain).
Indicators	Indicator LED's are highly visible, located beneath a raised transparent Lexan® dome on top of the sensor. **POWER** (red) LED (emitters only) lights whenever 5 - 15V dc power is applied **SIGNAL** (red) LED lights whenever the sensor sees its modulated light source
Construction	Molded thermoplastic polyester housing, o-ring sealed transparent Lexan® top cover, molded acrylic lenses, and stainless steel hardware. Q45s are designed to withstand 1200 psi washdown. The base of cabled models has a ½" NPS integral internal conduit thread.
Environmental Rating	NEMA 6P, IEC IP67
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or 4-pin euro-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 421 and Accessories section.
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Design Standards	Q45AD9 Series sensors comply with the following standards: DIN 19 234, EN 50 014 Part 1. 1977, EN 50 020 Part 7. 1977
Certifications	CE, CSA Exia ® NRTL/C, Ex KEMA, ETL LISTED 107674, FM APPROVED

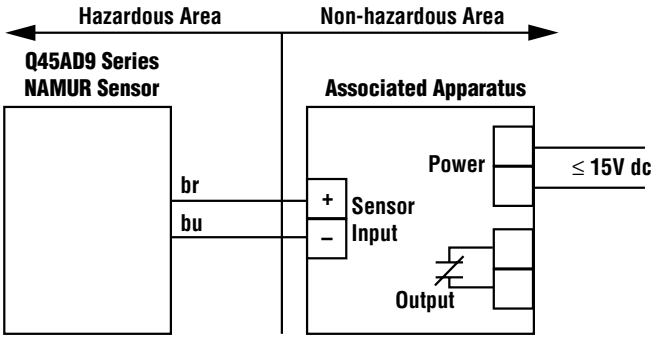
Lexan® is a registered trademark of General Electric Co.

APPROVALS

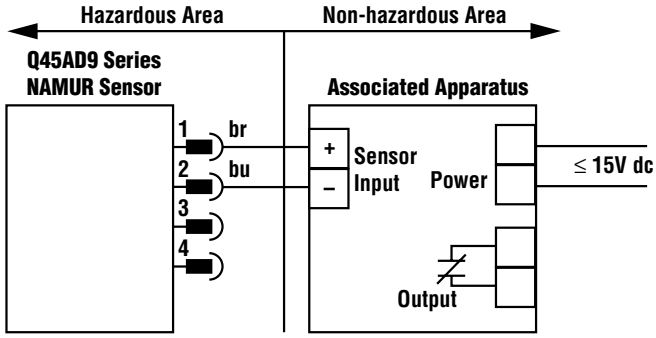
CSA:	#LR 41887	Instrinsically Safe, with Entity for: Class I, Groups A-D Class I, Div. 2, Groups A-D
FM:	#J.I. 5Y3A4.AX	Intrinsically Safe, with Entity for: Class I, II, III, Div. 1, Groups A-G Class I, II, III, Div. 2, Groups A-D and G
KEMA:	3Ex-95.C.3442	EEx ia IIC T6
ETL:	#558044	Tested per FM and CSA as shown above

Q45 NAMUR Hookup Diagrams

NAMUR Sensors with Attached Cable



NAMUR Sensors with Quick-Disconnect



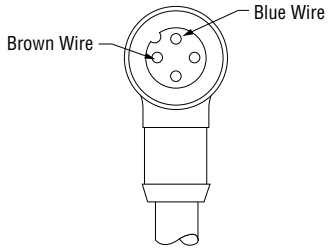
Entity Parameters

Associated Apparatus	Sensor
V_{oc} ≤ 15V dc	V_{max} = 15V dc
I_{sc} ≤ 60 mA	I_{max} = 60 mA
C_a ≤ *C(cable) + Ci	C_i = 0
L_a ≤ *L(cable) + Li	L_i = 0
$^*C_{(cable)}$ = 60 pF/ft	$^*L_{(cable)}$ = 0.2 µH/ft

Application Notes

The “Associated Apparatus” may include intrinsically safe amplifiers and barriers to monitor the sensor supply current, which is the sensor’s output signal. The associated apparatus must limit both supply voltage and supply current in the event of failure.

4-Pin Euro-Style Pin-out
(Cable Connector Shown)



Quick-Disconnect (QD) Option

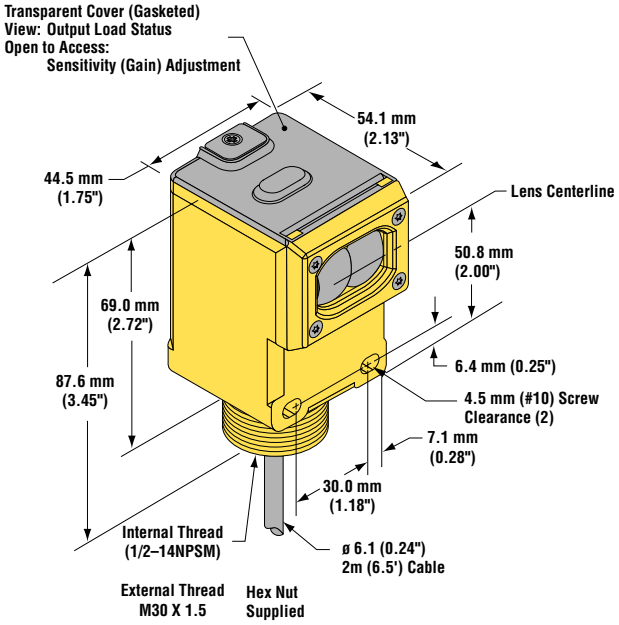
DC Q45 NAMUR Series sensors are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 4-pin euro-style QD cable fitting.

DC QD sensors are identified by the letter “Q” in their model number suffix. Mating cables for QD Q45 NAMUR sensors are specified on page 421 and in the Accessories section. Cables are supplied in a standard length of 5 m (15').

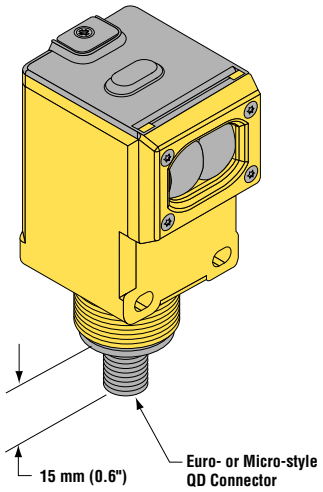
Q45 NAMUR Dimensions

NAMUR Series Opposed, Retro, and Diffuse Sensing Modes (model suffix E, R, D, DL, LP & LV)

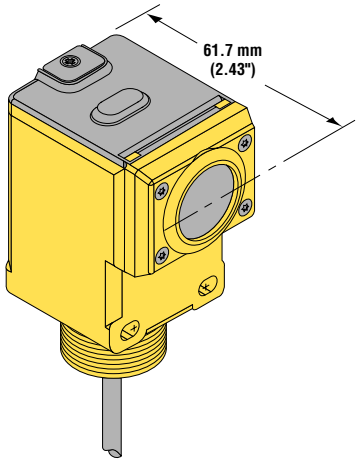
Cabled



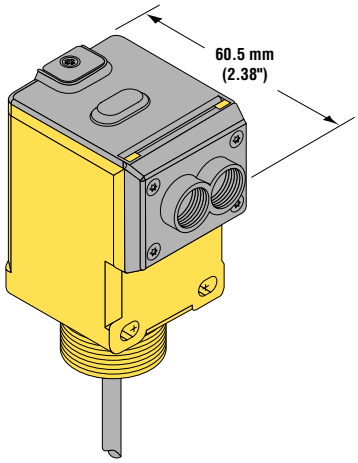
Quick-Disconnect 4-Pin Euro-Style



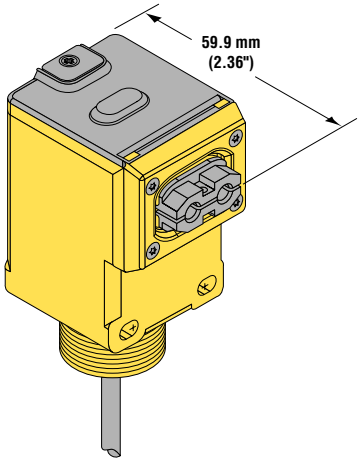
Convergent Sensing Mode (model suffix CV & CV4)



Glass Fiber Optic (model suffix F)



Plastic Fiber Optic (model suffix FP)



Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All Q45 Series sensors (except Q45X Bus Network models) may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	Q45BB6LV W/30

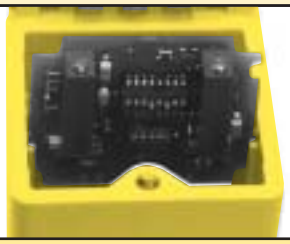
Quick-Disconnect (QD) Cables

Following is the selection of cables available for Q45 QD models. See the Accessories section for more cable information.
For information on QD cables for Q45X Bus Network sensors, contact a Banner sales engineer or Interlink BT.

Style	Model	Length	Connector	Used with:
3-Pin Mini	**MBCC-306** **MBCC-312** **MBCC-330**	2 m (6.5') 4 m (12') 9 m (30')	Straight	• Q45BW22 with QD connector (model suffix "Q") • Q452EQ & Q453EQ emitter
4-Pin Micro	**MQAC-406** **MQAC-415** **MQAC-406RA** **MQAC-415RA**	2 m (6.5') 5 m (15') 2 m (6.5') 5 m (15')	Straight Straight Right-angle Right-angle	• Q45BW22 Series with QD connector (model suffix "Q1") • Q452EQ1 emitter
4-Pin Mini	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')	Straight	• Q45BB6 and Q45BW13 Series with QD connector (model suffix "Q", except retro laser) • Q456Q emitter
4-Pin Euro	**MQDC-406** **MQDC-415** **MQDC-430** **MQDC-406RA** **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30') 2 m (6.5') 5 m (15') 9 m (30')	Straight Straight Straight Right-angle Right-angle Right-angle	• Q45BB6 Series with QD connector (model suffix "Q5") • Q456EQ5 emitter
4-Pin Euro (NAMUR)	**MQD9-406** **MQD9-415** **MQD9-406RA** **MQD9-415RA**	2 m (6.5') 5 m (15') 2 m (6.5') 5 m (15')	Straight Straight Right-angle Right-angle	• Q45AD9 Series NAMUR sensors with QD connector
5-Pin Mini	**MBCC-506** **MBCC-512** **MBCC-530**	2 m (6.5') 4 m (12') 9 m (30')	Straight	• Q45VR2, Q45VR3 and Q45X Series with QD connector • Q45BB6LL Retroreflective Laser sensors
5-Pin Euro	**MQDC1-506** **MQDC1-515** **MQDC1-530** **MQDC1-506RA** **MQDC1-515RA** **MQDC1-530RA**	2 m (6.5') 5 m (15') 9 m (30') 2 m (6.5') 5 m (15') 9 m (30')	Straight Straight Straight Right-angle Right-angle Right-angle	• Q45XDN and Q45XAS Sensors • Q45BB6LL & LLP Retroreflective Laser sensors

Output Timing Logic and Signal Strength Display Modules

Q45 sensors easily accept the addition of output timing logic and signal strength display functions. Display modules have a seven-element display which gives a "finer" indication of excess gain than does the AID™ system LED that is standard on most Q45 sensors. The modules listed below may be used with all Q45 sensors except NAMUR models.

Model	Logic and/or Display Function	
45LM58 **45LM58D** **45LMD**	Programmable output timing logic Programmable output timing logic plus signal strength display Signal strength display only (no timing function)	

Signal Strength Display

LED Number	Approximate Gain	Display
#1	0.25x E.G.	
#2	0.5x E.G.	
#3	1.0x E.G.	
#4	2.0x E.G.	
#5	4.0x E.G.	
#6	6.0x E.G.	
#7	8.0x E.G.	

Extension Cables (without connectors)

The following cables are available for extending the length of existing sensor cable. These are 30 m (100') lengths of Q45 cable. This cable may be spliced to existing cable. Connectors, if used, must be customer-supplied.

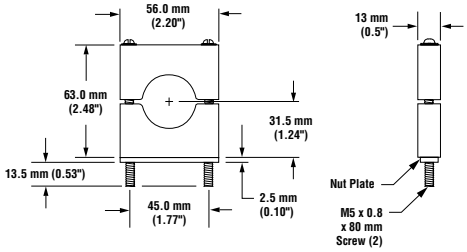
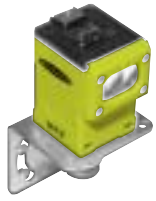
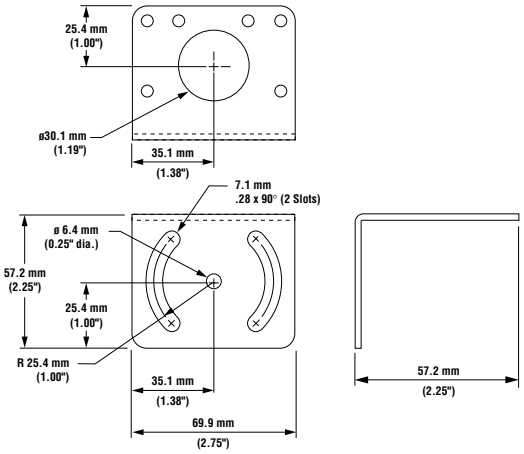
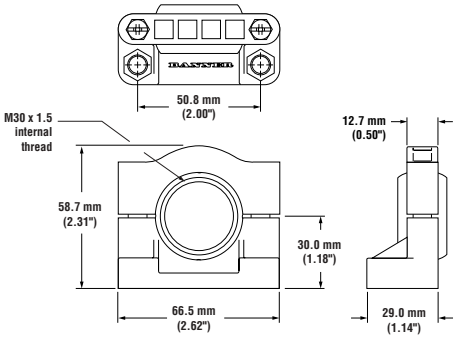
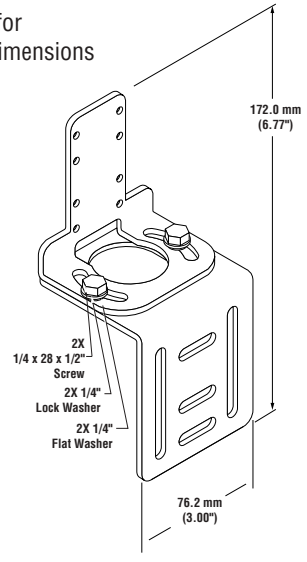
Model	Type	Used with:
EC312A-100	2-conductor	All emitters (except NAMUR)
EC900A-100	3-conductor	AC models (Q45BW22 Series)
EC312-100	4-conductor	DC models (Q45BB6 Series)
EC915-100	5-conductor	AC models (Q45VR2 Series)
ECAD9-100	2-conductor	All NAMUR models (Q45AD9 Series)

Replacement Lens Assemblies

Q45 Series lens assemblies are field-replaceable.

Model	Description
UC-45L	Replacement lens for E, R, DL, DX and LV
UC-45LL	Replacement lens for Laser Retro LL
UC-45LLP	Replacement lens for Polarized Laser Retro LLP
UC-45LP	Replacement lens for LP
UC-45D	Replacement lens for D
UC-45F	Replacement lens for F and FV
UC-45FP	Replacement lens for FP
UC-45C	Replacement lens for CV
UC-45C4	Replacement lens for CV4

Mounting Brackets

Model	Description	Dimensions
SMB30C 	• 30 mm split clamp bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting hardware	
SMB30MM 	• 30 mm, 12-gauge, stainless steel bracket with curved mounting slots for versatility and orientation • Clearance for M6 (1/4") hardware	
SMB30SC 	• 30 mm swivel bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting and swivel locking hardware	
SMB30UR 	• 2-piece universal swivel bracket for limit-switch style sensors • 300 series stainless steel • Includes stainless steel swivel locking hardware	NOTE: See p. 746 for additional dimensions 

NOTES:

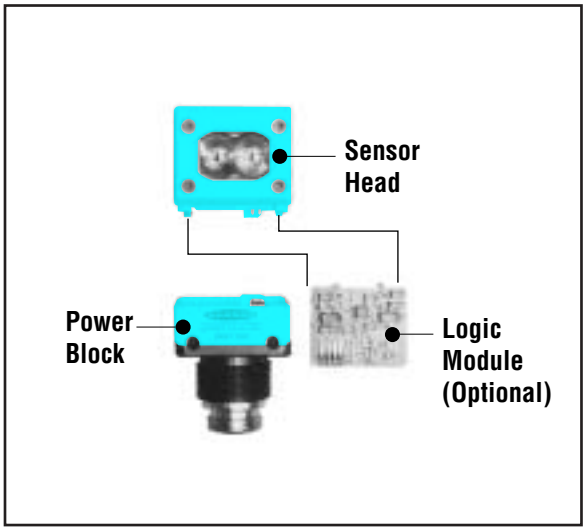
OMNI-BEAM® Sensors

(Except analog models)

OMNI-BEAM sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

Selection of Components for OMNI-BEAM Sensors

OMNI-BEAM sensors are modular self-contained photoelectric sensors which allow you to create a custom sensor exactly suited for the application. Choose standard OMNI-BEAM components for OMNI-BEAM sensors and analog OMNI-BEAM components for Analog OMNI-BEAM sensors.



STEP 1

Choose a sensor head with the required sensing mode

STEP 2

Choose a power block for the required sensor power (ac or dc) and interface

STEP 3

Choose an optional Timing Logic Module

NOTE: Analog OMNI-BEAM sensors do not accept timing logic modules

STEP 4

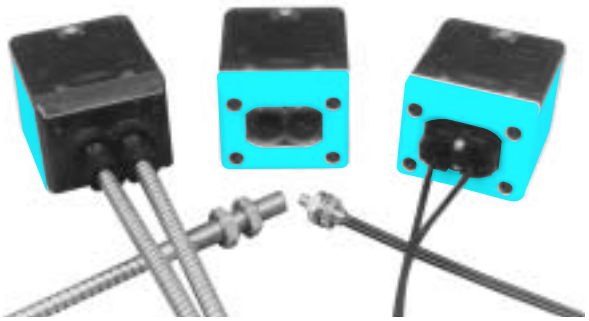
Simply plug and bolt components together without interwiring to create a complete self-contained photoelectric sensor that is tailored to your exact sensing needs

OMNI-BEAM modular components are sold separately. The three modular components, plus the lenses, are field-replaceable.

OMNI-BEAM Sensor Heads

- Sensor heads feature Banner's D.A.T.A.™ (Display And Trouble Alert) indicator system* which warns of an impending sensing problem before a failure occurs
- 10-element LED array displays sensing contrast and received signal strength and warns of a sensing problem due to any of the following causes:
  - Severe condensation or moisture
  - High temperature
  - Low supply voltage
  - Output overload (dc operation)
  - Too much sensing gain
  - Not enough sensing gain
  - Low optical contrast
- Separate indicators for target sensed and output energized
- Sensor heads are field-programmable for the following response parameters:
  - Sensing hysteresis
  - Signal strength indicator scale factor
  - Light or dark operate of the load output
  - Normally open or closed alarm output
- Choose power blocks for high-voltage ac or low voltage (10 to 30V) dc operation
- Sensor head and power block plug (and bolt) together quickly and easily
- Optional plug-in output timing modules may be added at any time

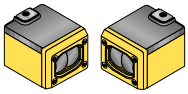
OMNI-BEAM Sensor Heads



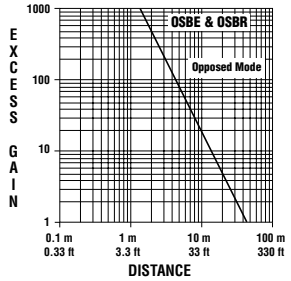
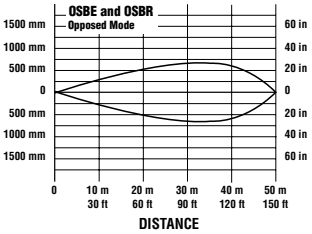
*U.S. Patent #4965548

OMNI-BEAM Sensor Head Sensing Mode Options

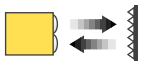
Infrared, 880 nm



OMNI-BEAM Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
OSBE **OSBR**	45 m (150')	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 0.01 milliseconds		Effective Beam: 25 mm 

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

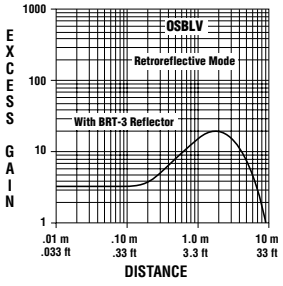
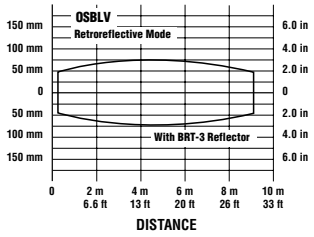
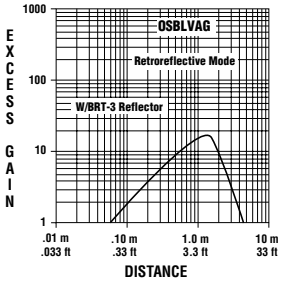
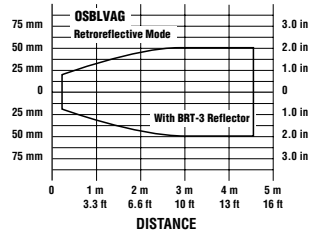


Non-Polarized

Visible red, 650 nm

Polarized

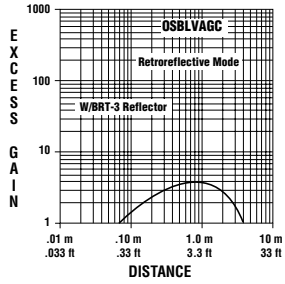
OMNI-BEAM Retroreflective Mode

Models	Range	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
Non-Polarized					
OSBLV	0.15 - 9 m (6" - 30')	Provided by Power Block (see page 437)	Response: 4 milliseconds Repeatability: 0.2 milliseconds		
Polarized					
OSBLVAG	0.3 - 4.5 m (12" - 15')	Provided by Power Block (see page 437)	Response: 4 milliseconds Repeatability: 0.2 milliseconds		

- Polarized retroreflective mode sensor head with low switching hysteresis design
- Low-hysteresis circuit enables the sensor to switch based on relatively small changes in received light signal levels
- Polarizing lens reduces the possibility of false sensor response due to reflections from the object to be sensed
- Ideal for many low-contrast sensing applications, especially clear object detection

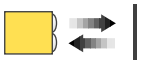
Visible Red, 650 nm

OMNI-BEAM Retroreflective Mode for Clear Object Detection

Models	Range	Supply Voltage	Response & Repeatability	Excess Gain
OSBLVAGC	4 m (12') w/BRT-3 Reflector	Provided by Power Block (see page 437)	Response: 4 milliseconds Repeatability: 0.2 milliseconds	

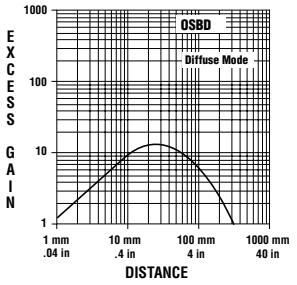
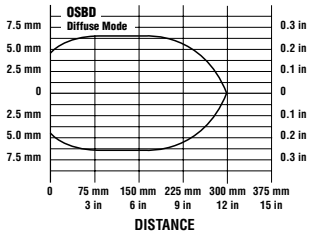
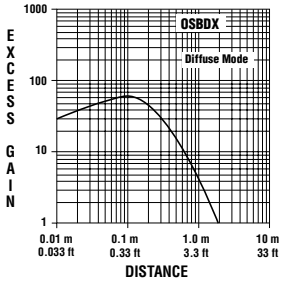
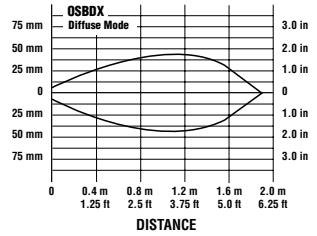
For OMNI-BEAM Sensor Heads:

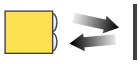
Sensor heads require a power block. See page 437 for power block information.



Infrared, 880 nm

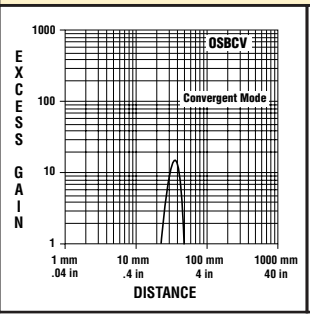
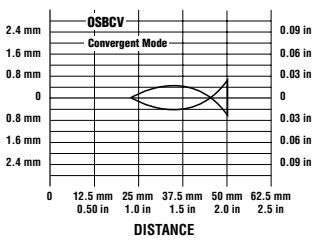
OMNI-BEAM Diffuse Mode

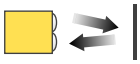
Models	Range	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
High Speed					
OSBD	300 mm (12")	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 1 millisecond		
High Power					
OSBDX	2 m (6.5')	Provided by Power Block (see page 437)	Response: 15 milliseconds Repeatability: 0.1 millisecond		



Visible red, 650 nm

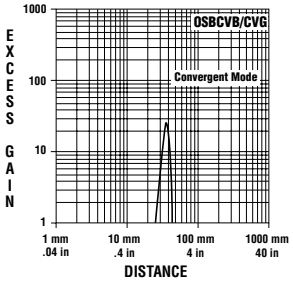
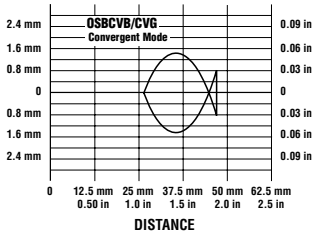
OMNI-BEAM Convergent Mode

Models	Focus	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
OSBCV	38 mm (1.5") Spot Size at Focus: 1.3 mm (0.05")	Provided by Power Block (see page 437)	Response: 4 milliseconds Repeatability: 0.2 milliseconds		



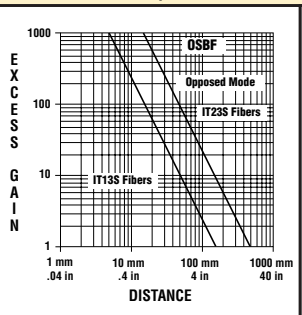
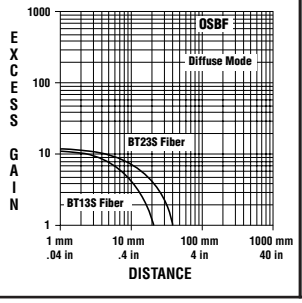
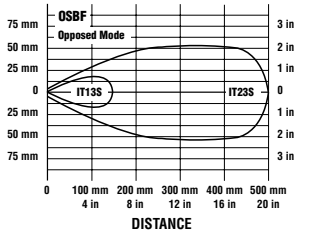
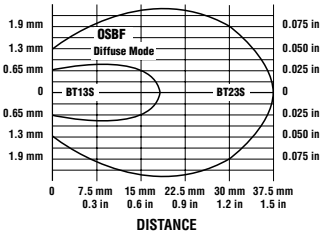
Visible red, 650 nm

OMNI-BEAM Convergent Mode

Models	Range	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
Visible Blue 475 nm					
OSBCVB	38 mm (1.5") Spot Size at Focus: 1.3 mm (0.05")	Provided by Power Block (see page 437)	Response: 4 milliseconds Repeatability: 0.2 milliseconds		
Visible Green 525 nm					
OSBCVG	38 mm (1.5") Spot Size at Focus: 1.3 mm (0.05")	Provided by Power Block (see page 437)	Response: 4 milliseconds Repeatability: 0.2 milliseconds		

Infrared, 880 nm

OMNI-BEAM Glass Fiber Optic - High Speed

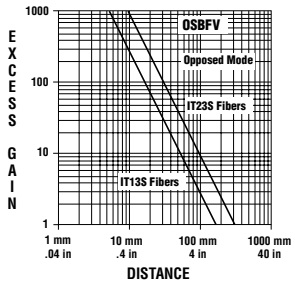
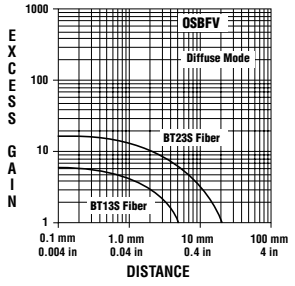
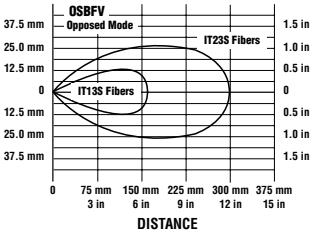
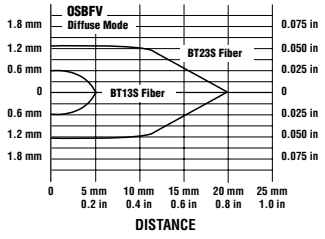
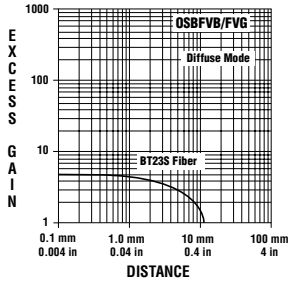
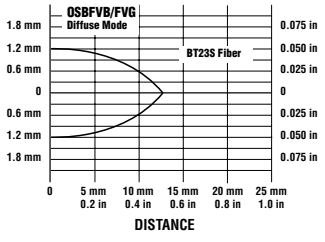
Models	Range	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
OSBF	Range varies by sensing mode and fiber optics used	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 0.1 milliseconds	 	 

For OMNI-BEAM Sensor Heads:

Sensor heads require a power block. See page 437 for power block information.

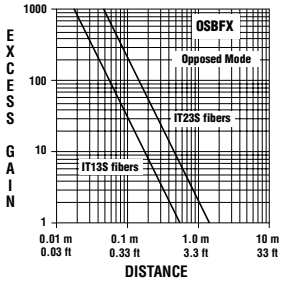
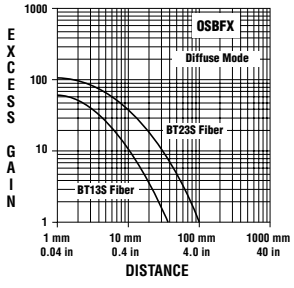
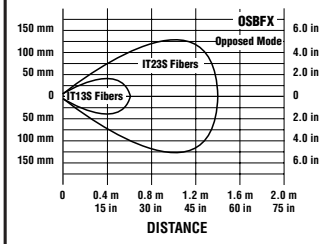
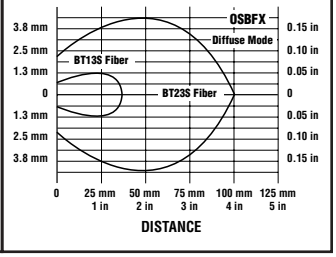
See Sensing Beam Information Below

OMNI-BEAM Glass Fiber Optic - High Speed

Models	Range	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
Visible Red 650 nm					
OSBFV	Range varies by sensing mode and fiber optics used	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 0.1 milliseconds	 	 
Visible Blue 475 nm					
OSBFVB	Range varies by sensing mode and fiber optics used	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 0.1 milliseconds		
Visible Green 525 nm					
OSBFVG	Range varies by sensing mode and fiber optics used	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 0.1 milliseconds		

Infrared, 880 nm

OMNI-BEAM Glass Fiber Optic - High Power

Models	Range	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
OSBFX	Range varies by sensing mode and fiber optics used	Provided by Power Block (see page 437)	Response: 15 milliseconds Repeatability: 1 millisecond	 	 

- Special-purpose ac-coupled fiber optic sensor head for response to very small light level changes
- Works together with any Banner standard or special glass fiber optic cable(s), ordered separately
- Typical applications include thread break detection, web flaw detection and detection of small randomly-falling parts

Infrared, 880 nm

OMNI-BEAM AC-Coupled Glass Fiber Optic

Models	Range	Supply Voltage	Response & Repeatability	Maximum Range
				Diffuse mode performance based on 90% reflectance white test card
OSBFAC	Range varies by sensing mode and fiber optics used	Provided by Power Block (see page 437)	Response: 1 millisecond Repeatability: 0.01 milliseconds	IT23S fibers, opposed mode: 180 mm (7")* IT13S fibers, opposed mode: 90 mm (3.5") BT23S fiber, diffuse mode: 15 mm (0.6") *Opposed mode range may be extended using optional lenses (see Accessories in the glass fiber optic section)

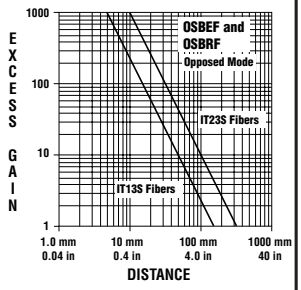
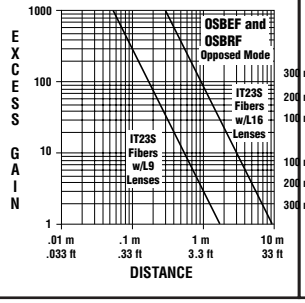
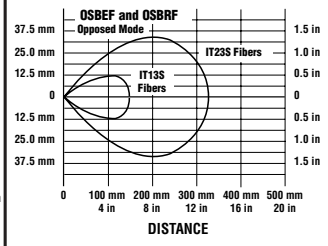
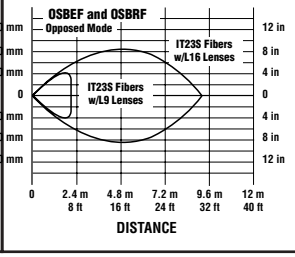
NOTE: Model OSBFAC requires use of model OLM8 or OLM8M1 slide-in logic module. Sensor head output is in the form of a quick pulse, and an OLM8 Series module is used to condition this pulse to the desired length. See page 436 for further information on these logic modules

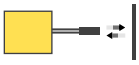
For OMNI-BEAM Sensor Heads:

Sensor heads require a power block. See page 437 for power block information.

Infrared, 880 nm

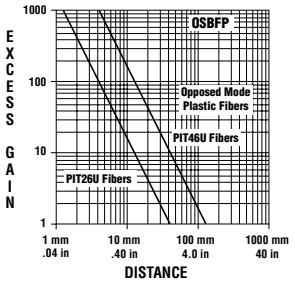
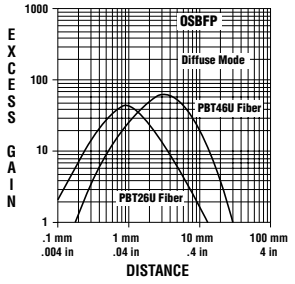
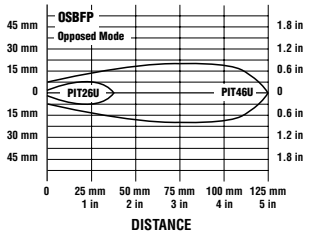
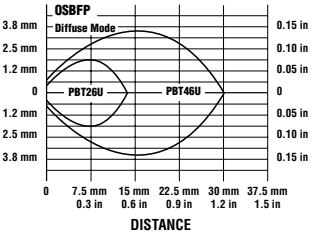
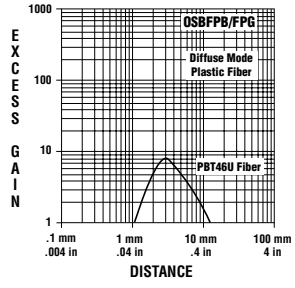
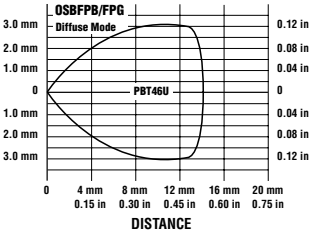
OMNI-BEAM Glass Fiber Optic Emitter (E) and Receiver (R)

Models	Range	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
OSBEF **OSBRF**	Range varies with fiber optics used	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 0.01 milliseconds	  	 



See Sensing Beam Information Below

OMNI-BEAM Plastic Fiber Optic

Models	Range	Supply Voltage	Response & Repeatability	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
Visible Red 650 nm					
OSBFP	Range varies by sensing mode and fiber optics used	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 0.1 milliseconds	 	 
Visible Blue 475 nm					
OSBFPB	Range varies by sensing mode and fiber optics used	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 0.1 milliseconds		
Visible Green 525 nm					
OSBFPG	Range varies by sensing mode and fiber optics used	Provided by Power Block (see page 437)	Response: 2 milliseconds Repeatability: 0.1 milliseconds		

For OMNI-BEAM Sensor Heads:

Sensor heads require a power block. See page 437 for power block information.

OMNI-BEAM Sensor Head Specifications

Supply Voltage and Current	Supplied by OMNI-BEAM power block
Output Response Time	See individual sensing heads for response times 200 millisecond delay on power-up: outputs are non-conducting during this time.
Adjustments	OMNI-BEAM sensor heads are field-programmable for four operating parameters. A set of four programming DIP switches is located at the base of the sensor head and is accessible with the sensor head removed from the power block SWITCH #1 selects the amount of sensing hysteresis SWITCH #2 selects the alarm output configuration SWITCH #3 selects LIGHT operate (switch #3 "OFF") or DARK operate (switch #3 "ON") SWITCH #4 selects the STANDARD (switch #4 "OFF") or FINE (switch #4 "ON") scale factor for the D.A.T.A. light signal strength indicator array Sensitivity: 15-turn slotted brass screw GAIN (sensitivity) adjustment potentiometer (clutched at both ends of travel).
Indicators	SENSE and LOAD indicator LEDs are located on the top of the sensor head on either side of the D.A.T.A. array. SENSE LED indicates when a target has been sensed LOAD LED lights whenever the load is energized Also, Banner's exclusive, D.A.T.A. sensor self-diagnostic system located on the top of the sensor head warns of marginal sensing conditions usually before a sensing failure occurs (except on model OSBFAC)
Construction	Sensor heads are molded of rugged thermoplastic polyester; top view window is LEXAN® polycarbonate; acrylic lenses; stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 12, and 13; IEC IP66 when assembled to power block
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE CSA® ®

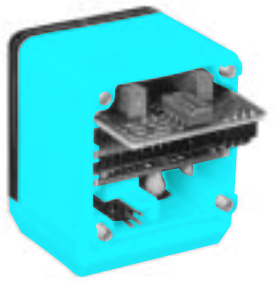
LEXAN® is a registered trademark of General Electric Co.

Relationship Between Excess Gain and D.A.T.A System Lights

D.A.T.A. Light LED Number	STANDARD Scale Factor	FINE* Scale Factor
#1	0.25x E.G.	0.5x E.G.
#2	0.35x E.G.	0.7x E.G.
#3	0.5x E.G.	0.8x E.G.
#4	0.7x E.G.	0.9x E.G.
#5	1.0x E.G.	1.0x E.G.
#6	1.3x E.G.	1.1x E.G.
#7	1.7x E.G.	1.2x E.G.
#8	2.2x E.G.	1.3x E.G.
#9	2.9x E.G.	1.7x E.G.
#10	3.7x E.G. (or more)	2.2x E.G. (or more)

* NOTE: the scale factor is selected by programming switch #4 inside the sensor head. "OFF" = STANDARD; "ON" = FINE. Use the FINE scale only for setup and monitoring of close-differential sensing applications where LOW hysteresis is required.

OMNI-BEAM Timing Logic Modules



OMNI-BEAM Timing Logic Modules slide into an OMNI-BEAM Sensor Head and interconnect without wires

- Logic modules for sensor output timing control simply slide into an OMNI-BEAM sensor head and interconnect without wires
- Programmable for several timing functions and time ranges via a set of four DIP switches located on the logic module
- Models for either Delay or Pulse timing
- 15-turn clutched potentiometers for accurate timing adjustments - easily accessible at the top of the sensor head

OMNI-BEAM Timing Logic Module

Models	Type	Logic Function	Timing Ranges	Timing Diagrams
OLM5	Delay Timer Logic Module	ON-DELAY or OFF-DELAY or ON/OFF DELAY	**ON-Delay:** 0.01 to 1 sec, 0.15 to 15 sec, or none **OFF-Delay:** 0.01 to 1 sec, 0.15 to 15 sec, or none	On-Delay Off-Delay On/Off-Delay
OLM8	Pulse Timer Logic Module	ONE-SHOT pulse timer or DELAYED ONE-SHOT logic timer	**Delay:** 0.01 to 1 sec, 0.15 to 15 sec, or none **Pulse:** 0.01 to 1 sec, 0.15 to 15 sec	One-Shot Delayed One-Shot
OLM8M1	Pulse Timer Logic Module	ONE-SHOT pulse timer or DELAYED ONE-SHOT logic timer	**Delay:** 0.002 to 0.1 sec, 0.03 to 1.5 sec, or none **Pulse:** 0.002 to 0.1 sec, 0.03 to 1.5 sec	

OMNI-BEAM Timing Logic Module Specifications

Response Time	A disabled timing function adds no measurable sensing response time
Timing Adjustments	All logic modules feature 15-turn clutched potentiometers for accurate timing adjustments. The logic module slides into the sensor head housing and interconnects without wires. Timing adjustments are easily accessible at the top of the sensor head and are protected by the sensor's transparent cover.
Timing Repeatability	± 2% of timing range (maximum); assumes conditions of constant temperature and power supply
Time Range	Useful range is from maximum time down to 10% of maximum (all models); when timing potentiometer is set fully counterclockwise, time will be approximately 1% of maximum for models OLM5 and OLM8, and 2% of maximum for model OLM8M1
Operating Temperature	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum Relative Humidity:** 90% at 50°C (non-condensing)
Certifications	

OMNI-BEAM Power Blocks

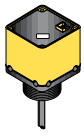
For Use with OMNI-BEAM Sensor Heads

- DC power blocks feature Banner's exclusive Bi-Modal™ output circuitry† for either sinking (NPN) or sourcing (PNP) interface requirements, depending upon the polarity of the power supply connections (see hookup diagrams)
- AC power blocks offer solid-state load output with switching capacity to 1/2 amp (see Specifications)
- Power blocks offer a dedicated output for the D.A.T.A.™ system alarm which may be used to run an audible or visual alarm or to send a warning signal to a process controller
- All OMNI-BEAM power blocks are available with either integral 2 m (6.5') cable or quick-disconnect (QD) connector; 9 m (30') integral cables are also available
- Sensor head and power block plug (and bolt) together quickly and easily

OMNI-BEAM power blocks provide the input and output circuitry for OMNI-BEAM sensor heads. Select models for either ac or dc power.

† U.S. Patent #4982107

DC Models



AC Models

OMNI-BEAM Power Blocks

Models	Cable	Supply Voltage	Output Type
DC Voltage			
OPBT2 **OPBT2QD** **OPBT2QDH**	2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD	10-30V dc	Bi-Modal™ NPN/PNP Two outputs: Load and Alarm
OPBTE **OPBTEQD** **OPBTEQDH**	2 m (6.5') 4-Pin Mini QD 4-Pin Euro QD		No output: for powering emitter only sensor heads
AC Voltage			
OPBA2 **OPBA2QD**	2 m (6.5') 5-Pin Mini QD	105-130V ac	SPST solid-state ac relay Two outputs: Load and Alarm
OPBB2 **OPBB2QD**	2 m (6.5') 5-Pin Mini QD	210-250V ac	
OPBAE **OPBAEQD**	2 m (6.5') 5-Pin Mini QD	105-130V ac	No output: for powering emitter only sensor heads
OPBBE **OPBBEQD**	2 m (6.5') 5-Pin Mini QD	210-250V ac	

For OMNI-BEAM Power Blocks:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled power block (e.g. - **OPBT2 W/30**)

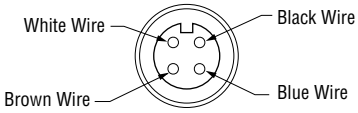
ii) A model with a QD connector requires an accessory mating cable. See pages 453 and the Accessories section for more information.

OMNI-BEAM DC Power Block Specifications

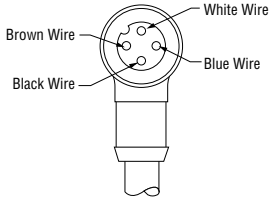
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 80 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	**OPBT2, OPBT2QD, OPBT2QDH:** Bi-Modal NPN or PNP, depending upon hookup to power supply (see hookup diagrams) **OPBTE, OPBTEQD, OPBTEQDH:** No output - for use with emitters only
Output Rating	100mA maximum **Off-state leakage current** less than 100 microamps **Output saturation voltage** (NPN or PNP outputs) less than 1 volt at 10 mA and less than 1.5 volts at 100 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Construction	Reinforced thermoplastic polyester housing with totally epoxy-encapsulated circuitry, and 30 mm threaded hub for swivel bracket or through-hole mounting
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 12, and 13; IEC IP66 when assembled to sensor head
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or 4-pin mini- or euro-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 453 and Accessories section.
Operating Conditions	**Temperature:** -40° to +70°C (-40 to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Interface to TTL logic is not direct (contact factory). When the load and the OMNI-BEAM do not share a common power supply, load voltage must be ≤ the sensor supply voltage
Certifications	

OMNI-BEAM DC Power Block Hookup Diagrams

4-Pin Mini-Style Pin-out
(Cable Connector Shown)



4-Pin Euro-Style Pin-out
(Cable Connector Shown)

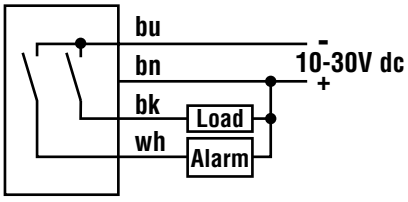


Quick-Disconnect (QD) Option

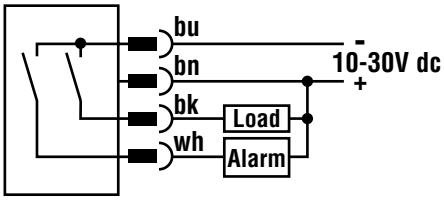
DC OMNI-BEAM power blocks are sold with either a 2 m (6.5') or 9 m (30') attached PVC-covered cable, or with a 4-pin mini- or euro-style QD cable fitting. Mating cables for QD sensors are specified on page 453 and in the Accessories section.

OMNI-BEAM DC Power Block Diagrams

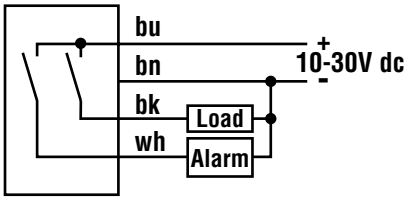
OPBT2 Power Blocks with Attached Cable
Current Sinking (NPN) Configuration



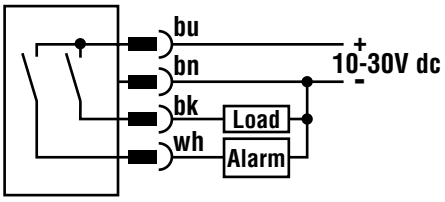
OPBT2 Power Blocks with Quick-Disconnect
Current Sinking (NPN) Configuration
(4-Pin Mini- or Euro-Style)



OPBT2 Power Blocks with Attached Cable
Current Sourcing (PNP) Configuration

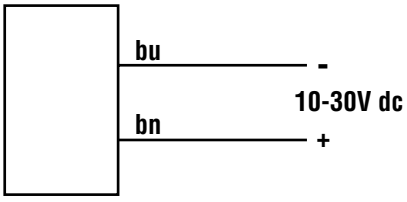


OPBT2 Power Blocks with Quick-Disconnect
Current Sourcing (PNP) Configuration
(4-Pin Mini- or Euro-Style)

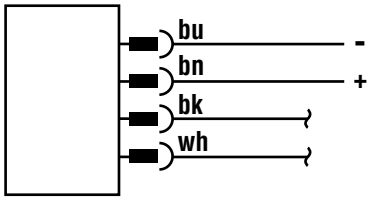


OPBTE Power Blocks
(For Opposed Mode Emitters)

OPBTE with Attached Cable



OPBTE with Quick-Disconnect
(4-Pin Mini- or Euro-Style)



NOTE: Model OPBT2 power blocks may be used to power opposed mode emitters, however, the output circuitry will be inactive.

OMNI-BEAM AC Power Block Specifications

Supply Voltage and Current	120V models: 105 to 130V ac, 50/60 Hz, 4 watts (excluding load) 220/240V models : 210 to 250V ac, 50/60 Hz, 4 watts (excluding load)
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	**OPBA2, OPBA2QD, OPBB2 and OPBB2QD:** Isolated SPST solid-state ac relay **OPBAE, OPBAEQD, OPBBE and OPBBEQD:** No output - for use with emitter only
Load Output Rating	500 mA max to 25°C, derated 1% per °C to 70°C; 7 amps max inrush for 1 second or 20 amps max for one cycle (non-repeating) **Off-state leakage current** less than 100 microamps maximum **On-state voltage drop** less than 3V ac at full load
Alarm Output Rating	200 mA max to 25°C, derated 2% per °C to 70°C; 2 amps max inrush for 1 second or 3 amps max for 1 cycle (non-repeating) **Off-state leakage current** less than 100 microamps maximum **On-state voltage drop** less than 2.5V ac at full load
Output Protection Circuitry	Protected against false pulse on power-up
Construction	Reinforced thermoplastic polyester housing with totally epoxy-encapsulated circuitry, and 30 mm threaded hub for swivel bracket or through-hole mounting
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 12, and 13; IEC IP66 when assembled with sensor head
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or 5-pin mini-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 453 and Accessories section.
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	

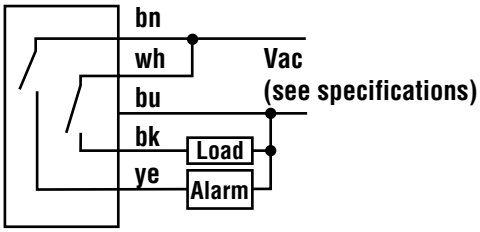
Quick-Disconnect (QD) Option

AC OMNI-BEAM power blocks are sold with either a 2 m (6.5') or 9 m (30') attached PVC-covered cable, or with a 5-pin mini-style QD cable fitting. Mating cables for QD sensors are specified on page 453 and in the Accessories section.

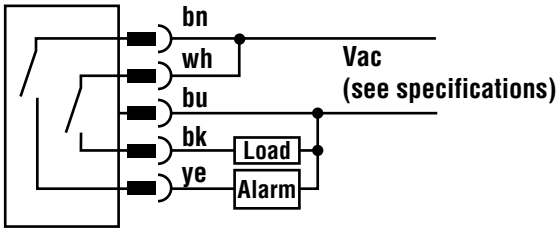
OMNI-BEAM AC Power Block Hookups

OPBA2 or OPBB2 Power Blocks

AC with Attached Cable

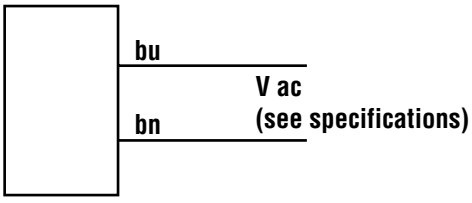


AC with Quick-Disconnect (5-Pin Mini-Style)

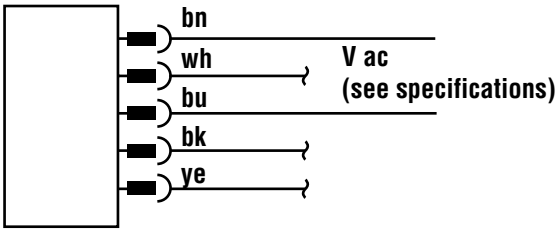


OPBAE or OPBBE Power Blocks (For Opposed Mode Emitters)

AC with Attached Cable

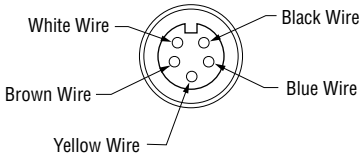


AC with Quick-Disconnect (5-Pin Mini-Style)



NOTE: OPBA2 or OPBB2 power blocks may be used to power opposed mode emitters, however, the output circuitry will be inactive.

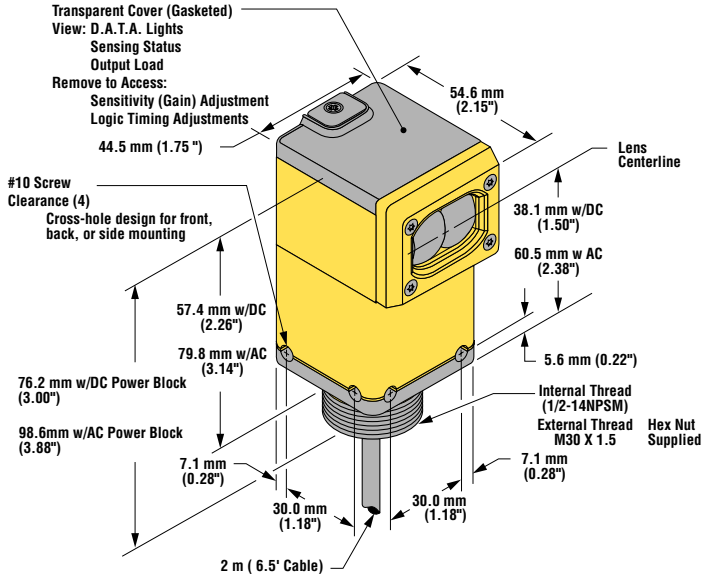
5-Pin Mini-Style Pin-out (Cable Connector Shown)



OMNI-BEAM Dimensions

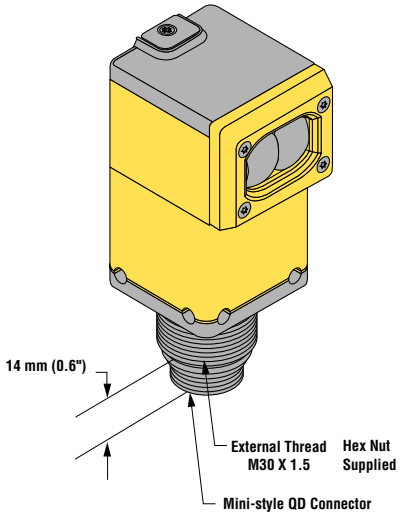
OMNI-BEAM Opposed, Retro, and Diffuse Sensing Modes (model suffix E, R, D, DX, LV, LVAG & LVAGC)

OMNI-BEAM Sensor with Attached Cable

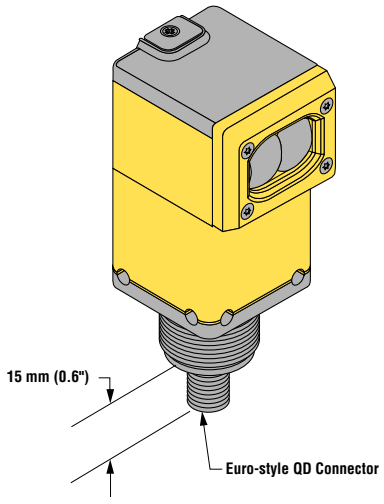


OMNI-BEAM Sensor with Quick-Disconnect

Mini-Style

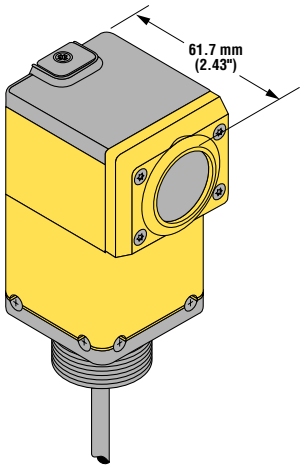


Euro-Style

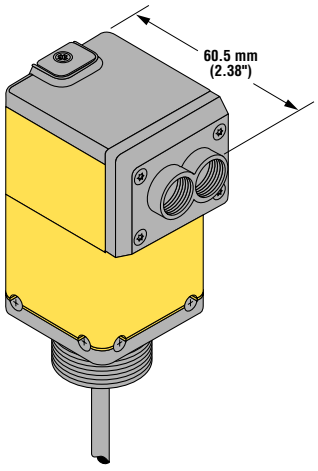


OMNI-BEAM Dimensions

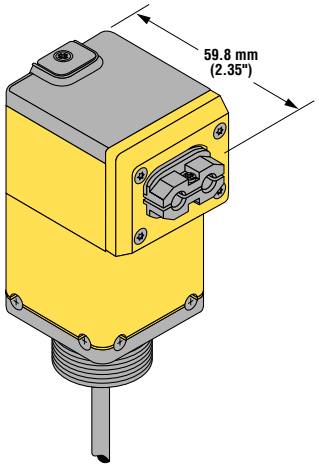
OMNI-BEAM Sensor - Convergent Sensing Mode (model suffix CV, CVB & CVG)



OMNI-BEAM Sensor - Glass Fiber Optic (model suffix F, FAC, FX, FV, FVB, FVG, EF & RF)



OMNI-BEAM Sensor - Plastic Fiber Optic (model suffix FP, FPB & FPG)



Analog OMNI-BEAM Sensor Heads

From bottom left to right - OMNI-BEAM Diffuse, Convergent, Plastic Fiber and Glass Fiber Optic Modes

- OMNI-BEAM modularity and optical performance with voltage sourcing analog outputs
- Two analog "mirror-image" outputs are ripple-free and temperature-stable
- Non-interactive NULL and SPAN controls for ease of adjustment
- Built-in 10-element LED display indicates output voltage
- Ideal for applications requiring a continuously-variable control voltage that is either directly or inversely related to photoelectric sensing response
- Select power blocks for either ac or dc sensor supply voltage

Analog OMNI-BEAM Sensor Head Sensing Mode Options

Understanding Excess Gain Curves for Analog OMNI-BEAM Sensors

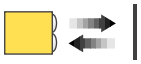
Excess gain curves (EGCs) may be used to predict the optical response of an analog sensor. For reference, see the EGC for diffuse mode model OASBD (top, right of page 445).

When the NULL control is adjusted to the setting where the inverting output just reaches 0 volts (or where the non-inverting output just reaches 10 volts), the excess gain of the sensor is equal to 4x. The excess gain curve indicates that model OASBD may be set to 4x excess gain with a white test card placed as close as 25 mm (1 in) from the sensor ("Min. NULL") or as far away as 140 mm (5.5 in) ("Max. NULL").

The minimum span required to produce a full 10 volt swing represents an optical contrast of 1.5:1 (i.e. a change in excess gain from 4x to 2.7x). Maximum SPAN corresponds to a contrast ratio of 16:1 (i.e. a change from 4x to 0.25x).

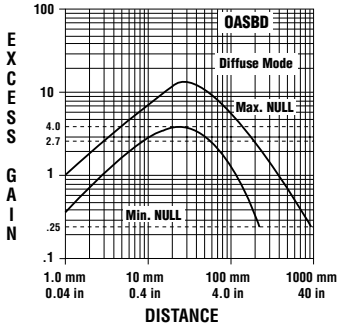
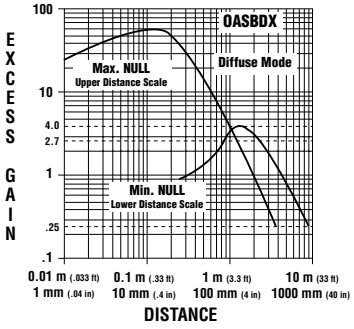
Knowing this, the excess gain curves for the OASBD predict that the sensing ranges (for a white test card) for the adjustment limits are:

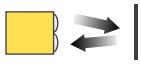
NULL	SPAN	Change in Excess Gain	Range of Measurement
Maximum	Maximum	4x to 0.25x	140 to 900 mm
Maximum	Minimum	4x to 2.7x	140 to 180 mm
Minimum	Maximum	4x to 0.25x	25 to 230 mm
Minimum	Minimum	4x to 2.7x	25 to 50 mm



Infrared, 880 nm

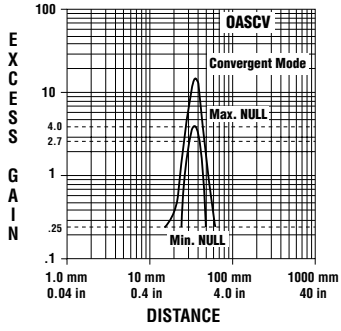
Analog OMNI-BEAM Diffuse Mode

Models	Range	Supply Voltage	Output	Excess Gain Performance based on 90% reflectance white test card
OASBD	0.9 m (36") (at max. NULL and max. SPAN)	Provided by Power Block (see page 449)	0 to 10V dc or 10 to 0V dc 10 mA max	
OASBDX	3.7 m (12') (at max. NULL and max. SPAN)		0 to 10V dc or 10 to 0V dc 10 mA max	



Visible Red, 650 nm

Analog OMNI-BEAM Convergent Mode

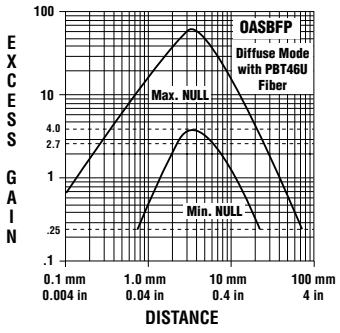
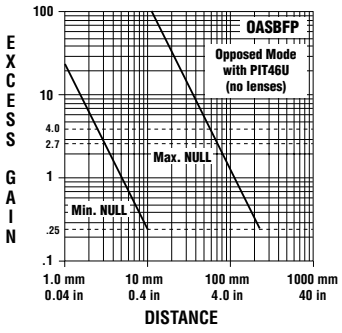
Models	Focus	Supply Voltage	Output	Excess Gain Performance based on 90% reflectance white test card
OASBCV	38 mm (1.5") Spot Size at Focus: 1.3 mm (0.05")	Provided by Power Block (see page 449)	0 to 10V dc or 10 to 0V dc 10 mA max	

For OMNI-BEAM Analog Sensors:

Analog sensor heads require an analog power block. See page 449 for power block information.

Visible red, 650 nm

Analog OMNI-BEAM Plastic Fiber Optic

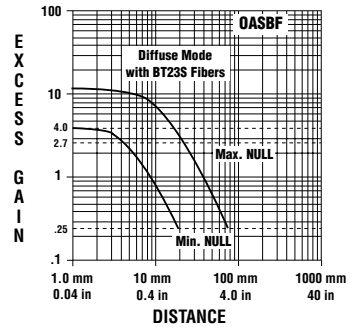
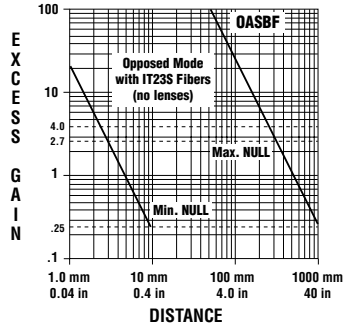
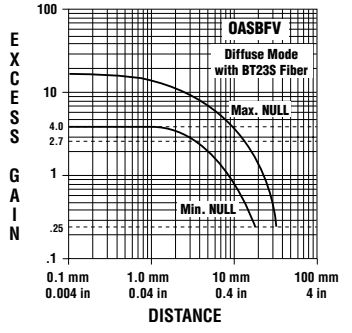
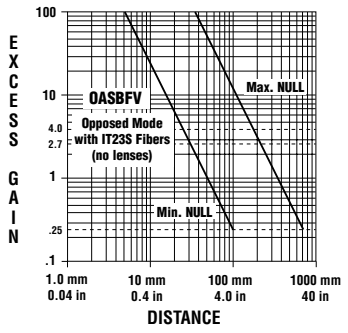
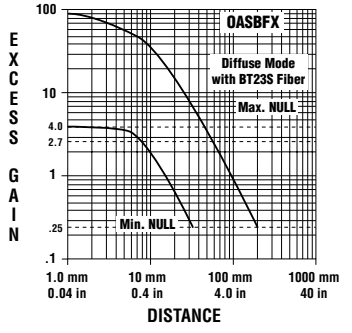
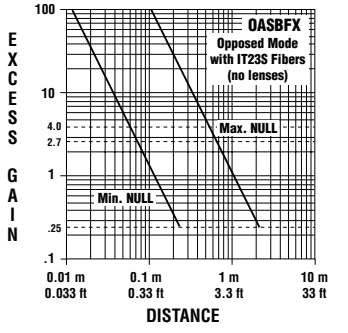
Models	Supply Voltage	Output	Excess Gain	
			Bifurcated Fiber, Diffuse	Individual Fiber Pair, Opposed
			Diffuse mode performance based on 90% reflectance white test card	
OASBFP	Provided by Power Block (see page 449)	0 to 10V dc or 10 to 0V dc 10 mA max		

For OMNI-BEAM Analog Sensors:

Analog sensor heads require an analog power block. See page 449 for power block information.

See Sensing Beam Information Below

Analog OMNI-BEAM Glass Fiber Optic

Models	Supply Voltage	Output	Excess Gain: Bifurcated Fiber, Diffuse	Excess Gain: Individual Fiber Pair, Opposed
			Diffuse mode performance based on 90% reflectance white test card	
Infrared 880 nm				
OASBF	Provided by Power Block (see page 449)	0 to 10V dc or 10 to 0V dc 10 mA max		
Visible Red 650 nm				
OASBFV	Provided by Power Block (see page 449)	0 to 10V dc or 10 to 0V dc 10 mA max		
High Power, Infrared 880 nm				
OASBFX	Provided by Power Block (see page 449)	0 to 10V dc or 10 to 0V dc 10 mA max		

Analog OMNI-BEAM Sensor Head Product Specifications

Supply Voltage and Current	Supplied by Analog power block
Output Response Time	Based on the time constant of an R-C network; the total output response time constant is the sum of the response time constant due to programming switch setting plus the base response time of the sensor head in use: **CV, D, F, FV and FP models:** 2 milliseconds; **DX and FX:** 4 milliseconds (base response time)
Adjustments	**NULL:** Null is adjusted (for the condition of greatest received light) until the #1 LED on the moving dot LED output display just turns "off" (only the POWER indicator LED should be "on" at this point). Further decrease the NULL adjustment until the inverting output just reaches 0 volts or until the non-inverting output just reaches +10V dc. **SPAN:** Span is adjusted to produce the desired voltage swing between the lightest and darkest sensing conditions. Minimum guaranteed signal contrast (i.e. minimum SPAN) which will result in a 10 volt output swing is 1.5:1. Maximum guaranteed signal contrast (i.e. minimum SPAN) that will result in a 10 volt output swing is 16:1. Both controls are 15-turn clutched (at both ends) potentiometers with slotted brass elements, located beneath a gasketed cover on top of the sensor. A small, flat-bladed screwdriver is required for adjustment.
Indicators	Located on top of the sensor head: Power ON: a red LED lights whenever power is applied to the power block Output: Ten-element moving-dot LED array indicates approximate output voltage
Construction	Sensor heads are molded of rugged thermoplastic polyester; top view window is LEXAN® polycarbonate; acrylic lenses; stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 12, and 13; IEC IP66 when assembled to power block
Operating Conditions	**Temperature:** 0° to +50°C (32° to +122°F) **Maximum relative humidity:** 95% at 50°C (non-condensing)
Application Notes	The output will not reach exactly zero volts. Actual minimum output: $0 < V_{min} < 100$ mV
Certifications	CE

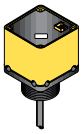
LEXAN® is a registered trademark of General Electric Co.

Analog OMNI-BEAM Power Blocks

For Use with Analog OMNI-BEAM Sensor Heads

- Power blocks provide power for analog OMNI-BEAM sensor heads and produce two ripple-free 0 to 10V sourcing analog outputs
- The two outputs, called inverting and non-inverting, are “mirror-images” which intersect at 5V dc
- Models for 15 to 30V dc, 105 to 130V ac and 210 to 250V ac sensor power
- Choose 2 m (6.5') integral cable or mini-style quick-disconnect (QD) connector; 9 m (30') integral cable is also available

OMNI-BEAM ac cabled and quick disconnect models shown



DC & AC Models

Analog OMNI-BEAM Power Blocks

Models	Cable	Supply Voltage	Output Type
DC Voltage			
OPBT3 **OPBT3QD**	2 m (6.5') 4-Pin Mini QD	+15-30V dc	Two “mirror-image” 0-10V dc sourcing analog
AC Voltage			
OPBA3 **OPBA3QD**	2 m (6.5') 5-Pin Mini QD	105-130V ac	Two “mirror-image” 0-10V dc sourcing analog
OPBB3 **OPBB3QD**	2 m (6.5') 5-Pin Mini QD	210-250V ac	

For Analog OMNI-BEAM Power Blocks:

i) 9 m (30') cables are available for analog power blocks by adding suffix **“W/30”** to the model number of any cabled power block (e.g. - **OPBT3 W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 453 and the Accessories section for more information.

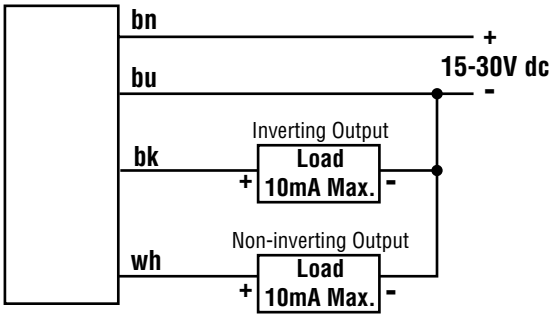
Analog OMNI-BEAM AC and DC Power Block Specifications

Supply Voltage and Current	+15 to 30V dc; 100 mA max, OPBT3 power block models 105 to 130V ac (50/60 Hz), OPBA3 power block models 210 to 250V ac (50/60 Hz), OPBB3 power block models
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	Two “mirror-image” 0 to 10V dc sourcing analog outputs
Load Output Rating	10 mA maximum. The two outputs may be used simultaneously. However, the maximum total load my not exceed 10 mA.
Construction	Reinforced thermoplastic polyester housing with totally epoxy-encapsulated circuitry, and 30 mm threaded hub for swivel bracket or through-hole mounting
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 12, and 13; IEC IP66 when assembled to sensor head
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or 4- or 5-pin mini-style quick-disconnect (QD) fitting are available. QD cables are ordered separately. See page 453 and Accessories section.
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Output Temperature Stability	Maximum drift is ±10 millivolts per degree C at the maximum SPAN setting; ±30 millivolts per degree C at minimum SPAN
Certifications	CE

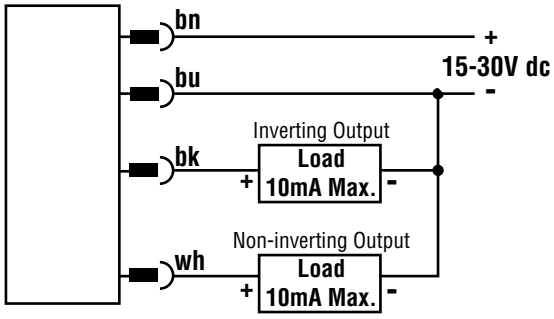
Analog OMNI-BEAM Power Block Hookup Diagrams

OPBT3 DC Power Blocks

OPBT3 with Attached Cable

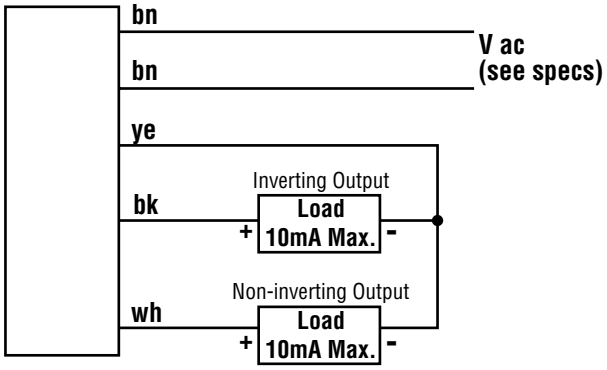


OPBT3 with Quick-Disconnect (4-Pin Mini-Style)

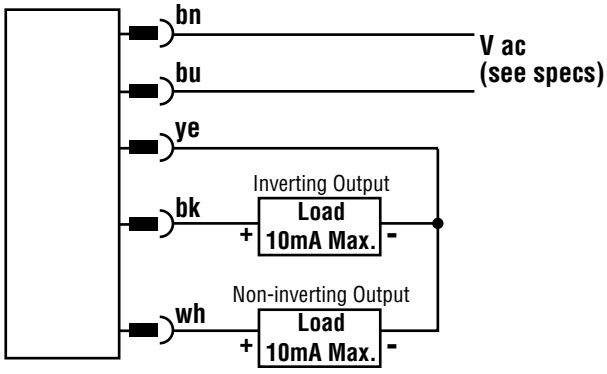


OPBA3 and OPBB3 AC Power Blocks

AC with Attached Cable

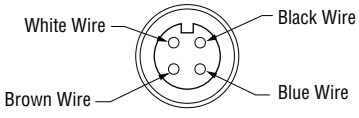


AC with Quick-Disconnect (5-Pin Mini-Style)

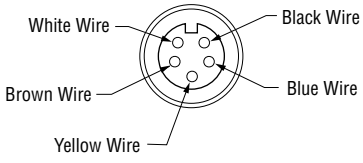


Quick-Disconnect Pin-Outs

4-Pin Mini-Style Pin-out
(Cable Connector Shown)



5-Pin Mini-Style Pin-out
(Cable Connector Shown)



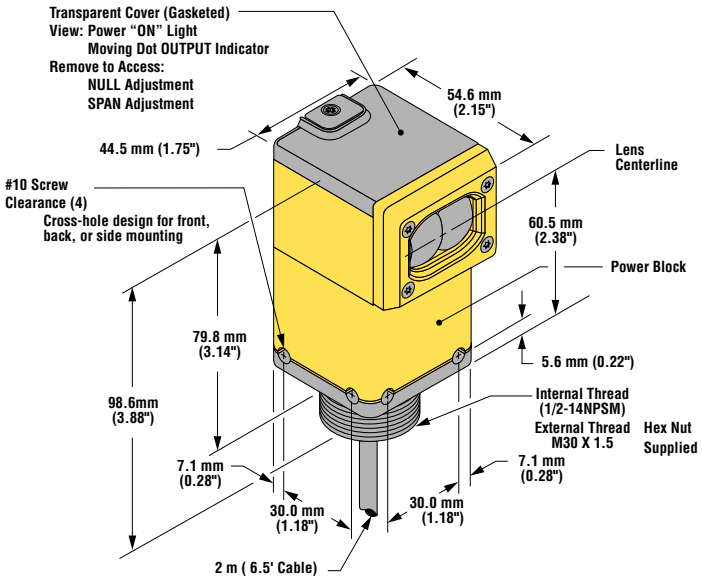
Quick-Disconnect (QD) Option

Analog OMNI-BEAM sensors are sold with either a 2 m (6.5') or 9 m (30') attached PVC-covered cable, or with a 5-pin mini-style (AC models) or 4-pin mini-style (DC models) QD cable fitting.
Analog OMNI-BEAM sensors are identified by the letters “QD” in their model number suffix. Mating cables for QD sensors are specified on page 453 and in the Accessories section.

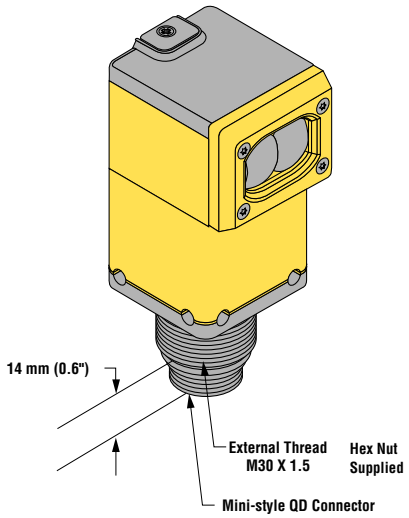
OMNI-BEAM Analog Dimensions

Analog OMNI-BEAM Diffuse Sensing Mode (model suffix D & DX)

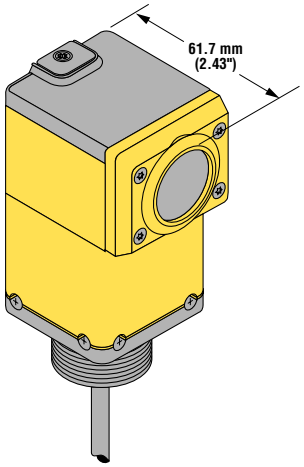
Cabled



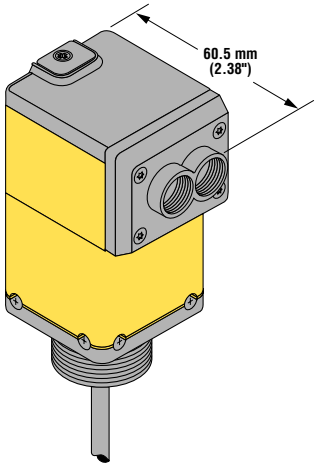
Quick-Disconnect Mini-Style



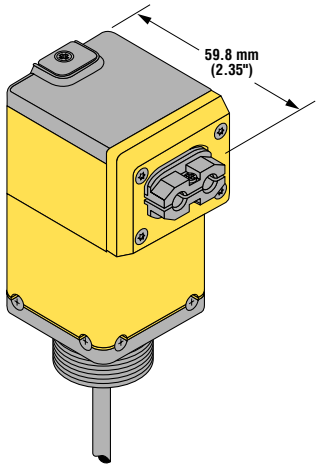
Convergent Sensing Mode (model suffix CV)



Glass Fiber Optic (model suffix F, FX & FV)



Plastic Fiber Optic (model suffix FP)



Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All OMNI-BEAM power blocks may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	OPBA2 W/30

Quick-Disconnect (QD) Cables

Following is the selection of cables available for OMNI-BEAM QD models. See the Accessories section for more cable information.

Style	Model	Length	Connector	Used with:
4-Pin Mini	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')	Straight	Power block models: OPBT2QD, OPBTEQD, OPBT3QD
5-Pin Mini	**MBCC-506** **MBCC-512** **MBCC-530**	2 m (6.5') 4 m (12') 9 m (30')	Straight	Power block models: OPBA2QD, OPBAEQD OPBB2QD, OPBBEQD OPBA3QD, OPBB3QD
4-Pin Euro	**MQDC-406** **MQDC-415** **MQDC-430** **MQDC-406RA** **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30') 2 m (6.5') 5 m (15') 9 m (30')	Straight Straight Straight Right-angle Right-angle Right-angle	Power block models: OPBT2QDH, OPBTEQDH

Replacement Lens Assemblies

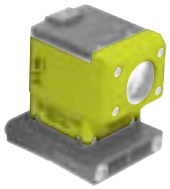
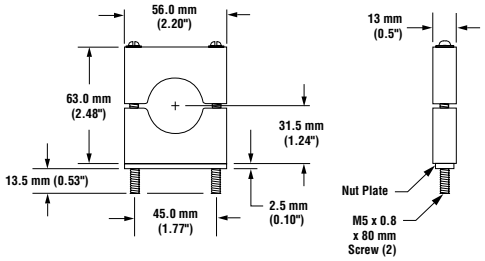
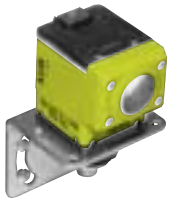
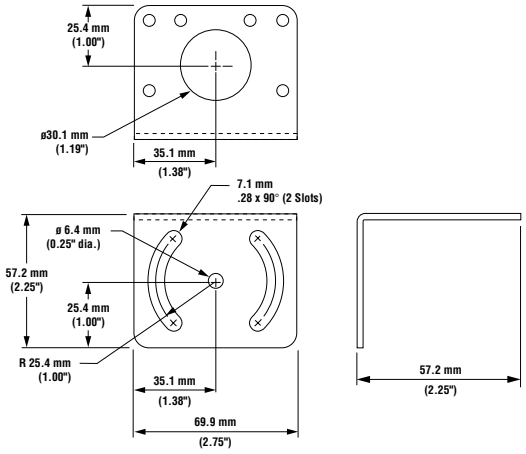
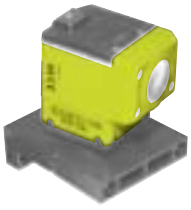
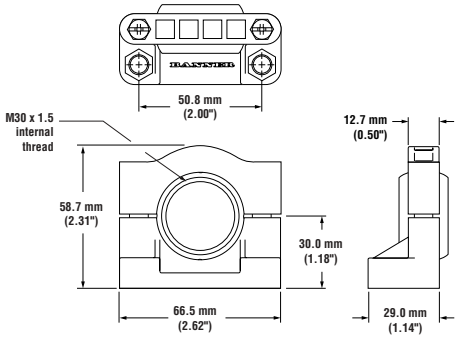
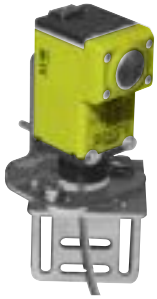
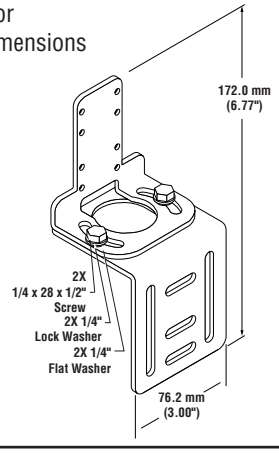
OMNI-BEAM lens assemblies are field-replaceable.

Model	Description
OUC-C	Replacement lens for convergent models (model suffix CV, CVB and CVG)
OUC-D	Replacement lens for short range diffuse models (model suffix D)
OUC-F	Replacement lens for glass fiber optic models (model suffix F, FAC, FV, FVB, FVG, FX, EF, and RF)
OUC-FP	Replacement lens for plastic fiber optic models (model suffix FP, FPB and FPG)
OUC-L	Replacement lens for non-polarized retroreflective and opposed models (model suffix DX, LV, E and R)
OUC-LAG	Replacement lens for polarized retroreflective models (model suffix LVAG and LVAGC)

Cable Protector

Model	Description	
HF1-2NPS	• Flexible black nylon cable protector • Includes a neoprene gland that compresses around the OMNI-BEAM cable to provide an additional seal against moisture • Resistant to gasoline, alcohol, oil, grease, solvents and weak acids • Working temperature range of -30° to +100°C (-22° to +212°F)	

Mounting Brackets

Model	Description	Dimensions
SMB30C 	• 30 mm split clamp bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting hardware	
SMB30MM 	• 30 mm, 12-gauge, stainless steel bracket with curved mounting slots for versatility and orientation • Clearance for M6 (1/4") hardware	
SMB30SC 	• 30 mm swivel bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting and swivel locking hardware	
SMB30UR 	• 2-piece universal swivel bracket for limit-switch style sensors • 300 series stainless steel • Includes stainless steel swivel locking hardware	NOTE: See p. 746 for additional dimensions 

Retroreflective Targets

Banner offers a wide selection of high-quality retroreflective targets. See Accessories section for complete information.

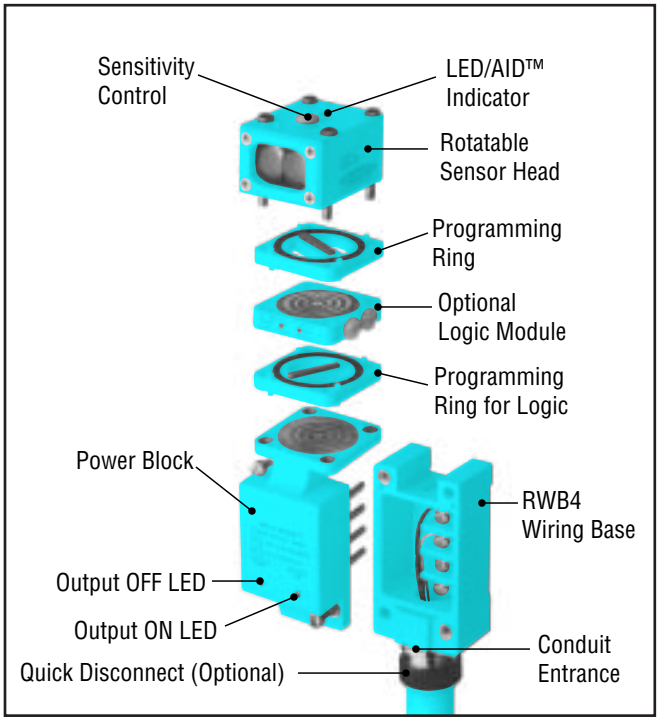
MAXI-BEAM® Sensors

(Most models, exceptions are noted)

MAXI-BEAM sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

SELECTION OF COMPONENTS FOR MAXI-BEAM SENSORS

MAXI-BEAM sensors are modular self-contained photoelectric sensors which allow you to create a custom sensor exactly suited for the application.



STEP 1

Choose a sensor head with the required sensing mode

STEP 2

Choose a power block for the required sensor power (ac or dc) and interface

STEP 3

Add an RWB4 wiring base

STEP 4

Choose an optional Timing Logic Module

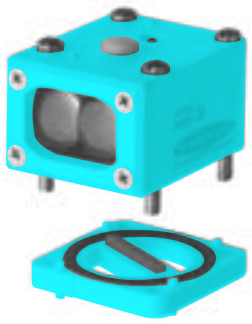
STEP 5

Simply plug and bolt components together without interwiring to create a complete self-contained photoelectric sensor that is tailored to your exact sensing needs

MAXI-BEAM modular components are sold separately. The three modular components, plus the lenses, are field-replaceable.

MAXI-BEAM Sensor Heads

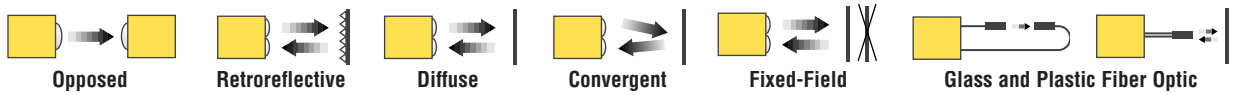
- Sensor heads use a unique* programming ring to select eight combinations of sensing range and output response
- The sensor head may be rotated on the power block in 90° increments
- All sensor heads feature Banner's AID™ (Alignment Indicating Device)† which indicates relative received light signal strength
- Sensitivity adjustment is via a multi-turn, clutched control
- Rugged construction, with reinforced thermoplastic polyester housing and epoxy-encapsulated circuitry



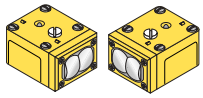
MAXI-BEAM sensor head with its programming ring

*U.S. Patent #4626053
† U.S. Patent #4356393

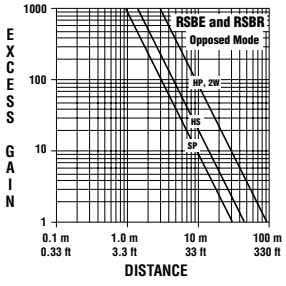
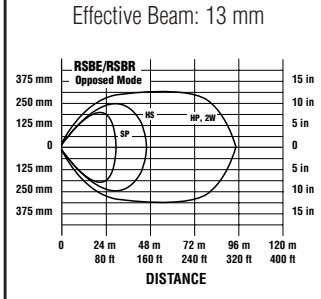
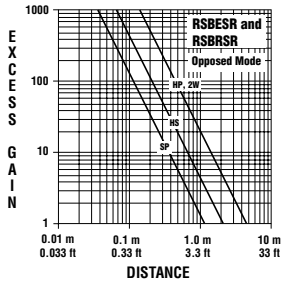
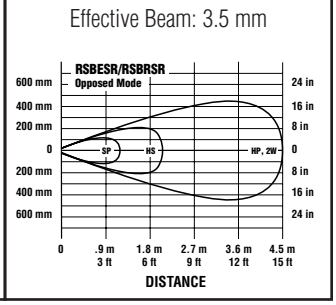
MAXI-BEAM Sensor Head Sensing Mode Options



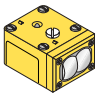
Infrared, 880 nm



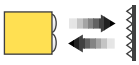
MAXI-BEAM Opposed Mode Emitter (R) and Receiver (R)

Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
RSBE* **RSBR**	90 m (300') in HP and 2W modes	**HP, 2W:** 10 ms on/5 off **HS:** 1 ms on/0.5 off **SP:** 0.3 ms on/off	**HP, 2W:** 1.4 ms **HS:** 0.1 ms **SP:** 0.04 ms		
RSBESR* **RSBRSR**	4.5 m (15') in HP and 2W modes	**HP, 2W:** 10 ms on/5 off **HS:** 1 ms on/0.5 off **SP:** 0.3 ms on/off	**HP, 2W:** 1.4 ms **HS:** 0.1 ms **SP:** 0.04 ms		

*MAXI-BEAM emitters have a visible red "tracer beam", a non-active beam that is used as a means of visual alignment during installation



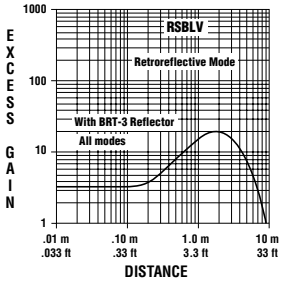
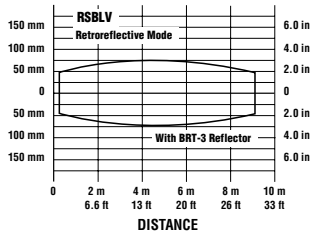
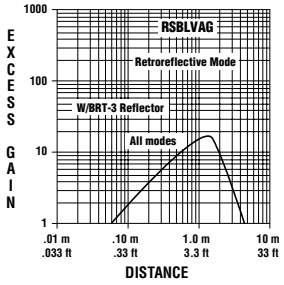
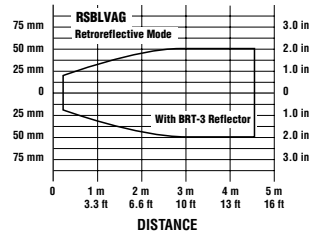
NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



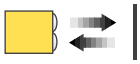
Visible Red, 650 nm

Non-Polarized *Polarized*

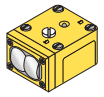
MAXI-BEAM Retroreflective Mode

Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
Non-Polarized					
RSBLV	0.15 - 9 m (6" - 30') in all modes	**HP, 2W, SP:** 4 ms **HS:** 1 ms	**HP, 2W, SP:** 1.3 ms **HS:** 0.3 ms		
Polarized*					
RSBLVAG	0.3 - 4.5 m (1 - 15') in all modes	**HP, 2W, SP:** 4 ms **HS:** 1 ms	**HP, 2W, SP:** 1.3 ms **HS:** 0.3 ms		

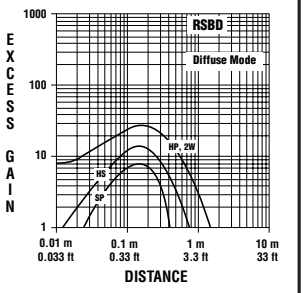
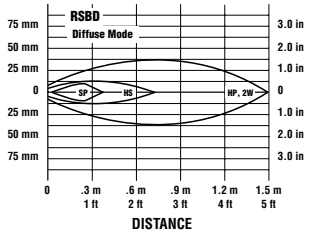
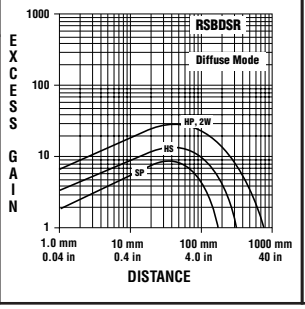
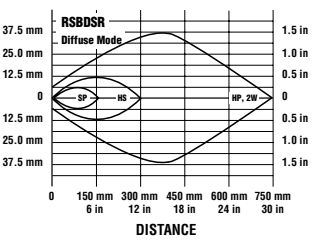
* Use polarized sensor head whenever shiny objects are sensed.

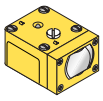


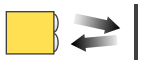
Infrared, 880 nm



MAXI-BEAM Diffuse Mode

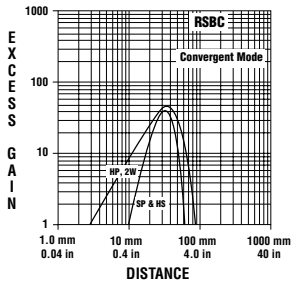
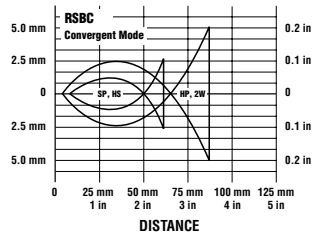
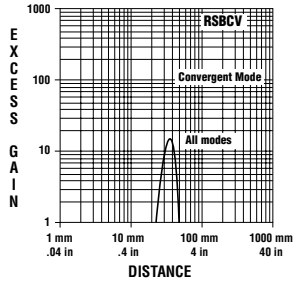
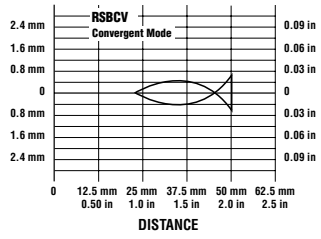
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
Long Range					
RSBD	1.5 m (5') in HP & 2W modes	**HP, 2W:** 10 ms **HS:** 1 ms **SP:** 0.3 ms	**HP, 2W:** 3.3 ms **HS:** 0.3 ms **SP:** 0.1 ms		
Short Range					
RSBDSR	760 mm (30") in HP & 2W modes	**HP, 2W:** 10 ms **HS:** 1 ms **SP:** 0.3 ms	**HP, 2W:** 3.3 ms **HS:** 0.3 ms **SP:** 0.1 ms		

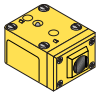


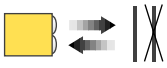


See Sensing Beam Information Below

MAXI-BEAM Convergent Mode

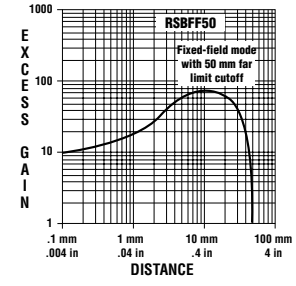
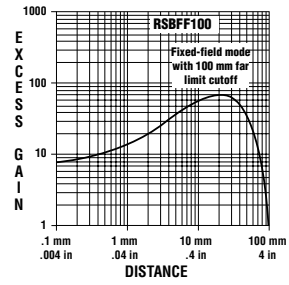
Models	Focus	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
Infrared 940 nm					
RSBC	38 mm (1.5")	**HP, 2W:** 10 ms **HS:** 1 ms **SP:** 0.3 ms	**HP, 2W:** 3.3 ms **HS:** 0.3 ms **SP:** 0.1 ms		
Visible Red 650 nm					
RSBCV	38 mm (1.5") Spot Size at Focus: 1.5 mm (0.06")	**HP, 2W:** 10 ms **HS:** 1 ms **SP:** 0.3 ms	**HP, 2W:** 3.3 ms **HS:** 0.3 ms **SP:** 0.1 ms		





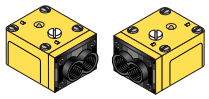
Infrared, 880 nm

MAXI-BEAM Fixed-Field Mode*

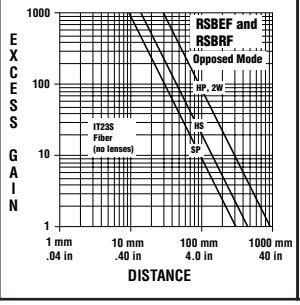
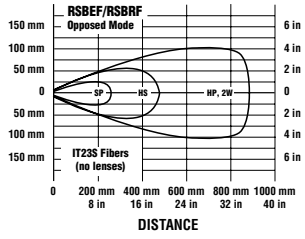
Models	Cutoff Point	Response	Repeatability of Response	Excess Gain (50 mm)	Excess Gain (100 mm)
				Performance based on 90% reflectance white test card	
RSBFF50*	50 mm (2")	**HP:** 10 ms	**HP:** 3.3 ms		
RSBFF100*	100 mm (4")				

*Fixed-field sensor heads are programmable for HP mode, only and will not operate with 2-wire power blocks

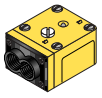
Infrared, 880 nm



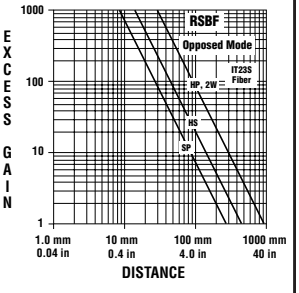
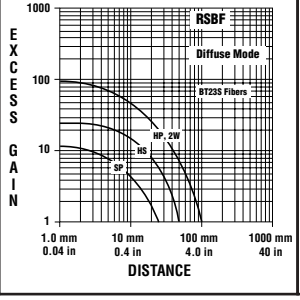
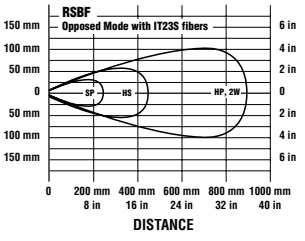
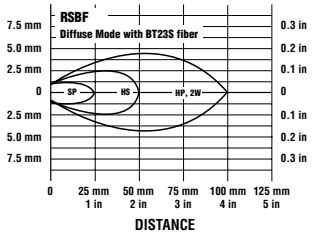
MAXI-BEAM Glass Fiber Optic Emitter (E) and Receiver (R)

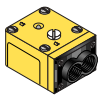
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
RSBEF **RSBRF**	Range varies with fiber optics used	**HP, 2W:** 10 ms **HS:** 1 ms **SP:** 0.3 ms on/off	**HP, 2W:** 3.3 ms **HS:** 0.3 ms **SP:** 0.1 ms		

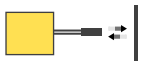
Infrared, 880 nm



MAXI-BEAM Glass Fiber Optic

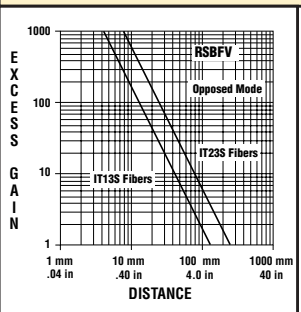
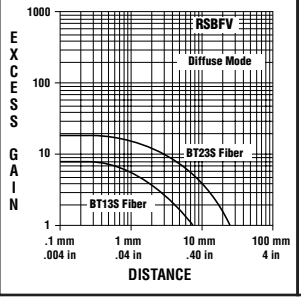
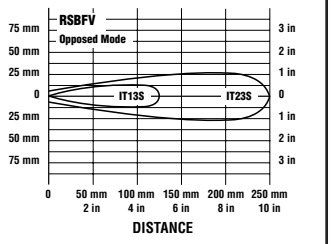
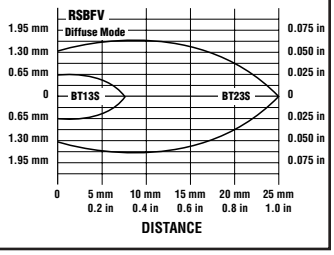
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
RSBF	Range varies by sensing mode and fiber optics used	**HP, 2W:** 10 ms **HS:** 1 ms **SP:** 0.3 ms on/off	**HP, 2W:** 3.3 ms **HS:** 0.3 ms **SP:** 0.1 ms	 	 





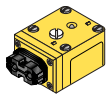
Visible red, 650 nm

MAXI-BEAM Glass Fiber Optic - High Speed

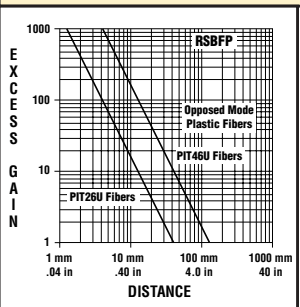
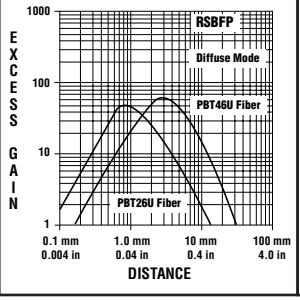
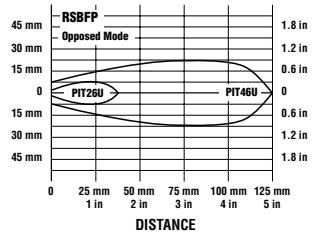
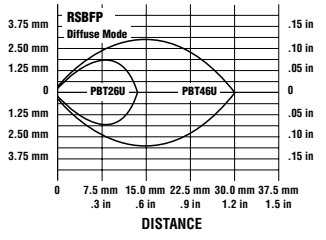
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
RSBFV*	Range varies by sensing mode and fiber optics used	HS: 1 ms on/off	HS: 0.3 ms	 	 

*NOTES: i) Sensor head models RSBFV and RSBFP are programmable for HS mode, only.
ii) Sensor head models RSBFV and RSBFP will not operate with 2-wire power blocks.

Visible Red, 650 nm



MAXI-BEAM Plastic Fiber Optic - High Speed

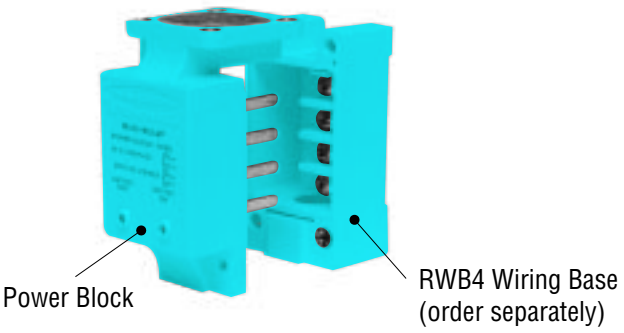
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
RSBFP*	Range varies by sensing mode and fiber optics used	HS: 1 ms on/off	HS: 0.3 ms	 	 

MAXI-BEAM Sensor Head Specifications

Supply Voltage and Current	Supplied by power block
Output Response Time	Programmable for 10, 1 and 0.3 milliseconds (except FF, FV and FP models) See power block specifications for information on additional output switching response delays (NOTE: 100 millisecond delay on power-up)
Repeatability	See individual sensor mode charts
Adjustments	Located on top of sensor head beneath o-ring gasketed cover. 15-turn clutched control (rotate clockwise to increase gain)
Indicators	Red LED on top of sensor head. Banner's exclusive, patented Alignment Indicating Device (AID™) circuit lights the LED whenever the sensor detects its own modulated light source, and pulses the LED at a rate proportional to the received light signal strength.
Construction	Reinforced thermoplastic polyester with totally encapsulated circuitry, molded acrylic lenses, and o-ring and quad-ring gasketed components
Environmental Rating	Meets NEMA standards 1, 3, 4, 12, and 13; IEC IP66
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE, CSA® [1], UL LISTED, c UL LISTED Models: RSBESR, RSBRSR, RSBC, RSBFF50, and RSBFF100

[1] Except sensor head models RSBESR, RSBRSR, RSBC, RSBFF50, and RSBFF100

MAXI-BEAM Power Blocks

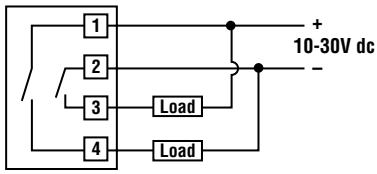
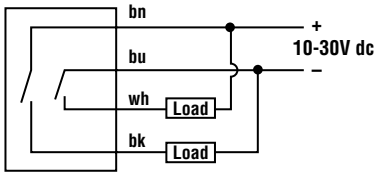
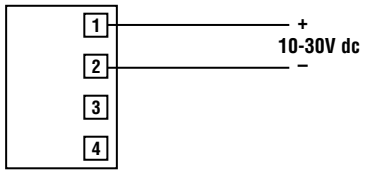


- All MAXI-BEAM power blocks plug into an RWB4 wiring base (see below)
- The RWB4 wiring base is NECESSARY for all MAXI-BEAM assemblies (except sensors using the RPBTLM power block), and must be purchased separately
- MAXI-BEAM power blocks provide regulated low voltage dc power to the sensor head and logic module (if one is used) and are are epoxy-encapsulated
- All power blocks (except emitter-only types) contain an output switch for interfacing to loads or to control circuitry
- All power blocks (except emitter-only types) include two status LEDs which continuously indicate the state of the output circuit and input power

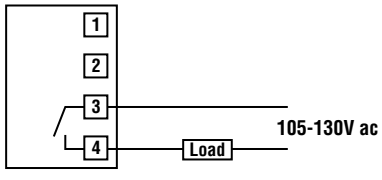
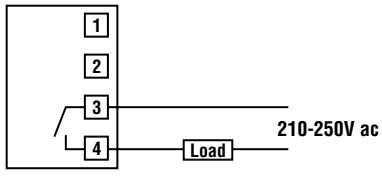
MAXI-BEAM Wiring Base

Model	Description	
RWB4	• The RWB4 wiring base is used for all MAXI-BEAM assemblies, except those using power block model RPBTLM (see dimension drawings, page 470). It is sold as a separate item. • The RWB4 is designed so that a power block plugs (and bolts) directly into it. The RWB4 may be permanently installed, and all other MAXI-BEAM sensing components may be quickly and easily exchanged, without disturbing the field wiring. • The RWB4 offers heavy-duty screw terminals which accept up to #12 gauge wire (no lugs are necessary).	 *Shown with optional quick-disconnect connector and cable*

MAXI-BEAM DC Power Blocks

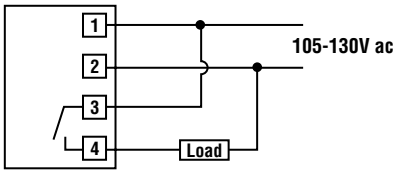
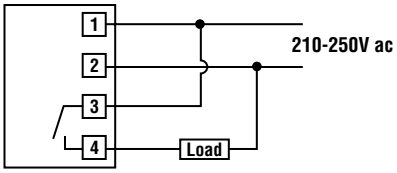
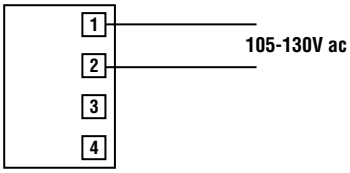
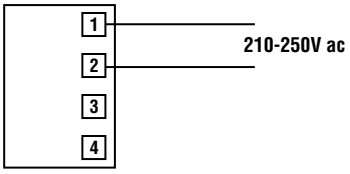
Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
RPBT	10 - 30V dc 20 mA max	Bi-Polar NPN/PNP	250 mA each output	PNP <1V at 10 mA <2V at 250 mA NPN <200mV at 10 mA <1V at 250 mA	<10 µA	
RPBTLM[3]	10 - 30V dc 10 mA max		150 mA each output	NPN: <200mV at 10 mA <1V at 150 mA PNP: <1V at 10 mA <2V at 150 mA	<1 µA	
RPBT-1	10 - 30V dc 20 mA max	For RSBE, RSBESR and RSBEF emitters				

MAXI-BEAM AC 2-Wire Power Blocks

Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
R2PBA	105 - 130V ac	SPST Solid-state	130V ac max 750 mA max	<5.2V rms at ½ amp load; <14V rms at 10 mA load	<1.7 mA	
R2PBB	210 - 250V ac		250V ac max 750 mA max			

[3] Power block models RPBTLM, RPBU and RPBR2 do not carry UL or CSA approval.

MAXI-BEAM AC 3- and 4-Wire Power Blocks

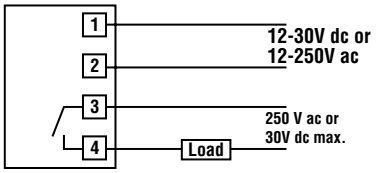
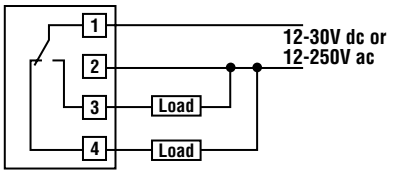
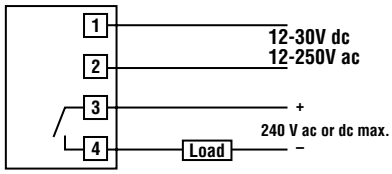
Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
RPBA*	105 - 130V ac	SPST Solid-state	250V ac max 750 mA max	<2.5V ac	<100 µA	
RPBB*	210 - 250V ac					
RPBA-1	105 - 130V ac	For RSBE, RSBESR and RSBEF emitters				
RPBB-1	210 - 250V ac					

* Special order models RPBAT (120V ac) and RPBBT (240V ac) are available for interfacing to dc loads of up to 100 milliamps

[1] Hookup to dc power is without regard to polarity.

[2] Power block models RPBR and RPBR2 use “partial phase firing” power conversion. The collective current demand of several of these power blocks on a common ac line is significant. If this is a consideration, contact your local Banner sales engineer or the factory Application Engineering Department for advice. Power demand is not an issue when the RPBR or RPBR2 are powered from direct current (12-30V dc).

MAXI-BEAM AC/DC Power Blocks

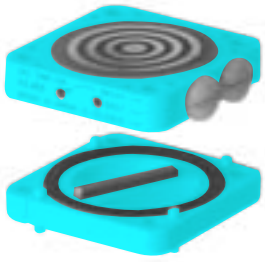
Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
RPBR	12 - 30V dc[1] or 12 - 250V ac[2] 40 mA max	SPST Electro-mechanical relay	250V ac max 30V dc max 5A max	Nil	Nil	
RPBR2[3]	12 - 30V dc[1] or 12 - 250V ac[2] 40 mA max	SPDT Electro-mechanical relay	250V ac max 30V dc max 5A max	Nil	Nil	
RPBU[3]	12 - 30V dc[1] or 12 - 250V ac 40 mA max	SPST Isolated Solid-state	240V ac or dc max 100 mA max	<2V at 100 mA	<1 mA	

MAXI-BEAM AC and DC Power Block Specifications

Supply Voltage and Current	See individual model specifications
Supply Protection Circuitry	Protected against transient voltages. DC power blocks are protected against reverse polarity.
Output Configuration	See individual model specifications
Output Protection Circuitry	Protected against false pulse on power-up. DC power blocks are protected against continuous overload or short circuit of outputs.
Output Response Time	For ac loads: add 8.3 milliseconds to the off-time response of the sensor block
Construction	Reinforced thermoplastic polyester, with epoxy-encapsulated circuitry, 30 mm threaded hub for swivel bracket or through-hole mounting
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 12, and 13; IEC IP66 when assembled with sensor head
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) except models RPBR and RPBR2 which are -40° to +50°C (-40° to +122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE, CSA® [3], UL LISTED [3]

[3] Power block models RPBTLM, RPBU and RPBR2 do not carry UL or CSA approval.

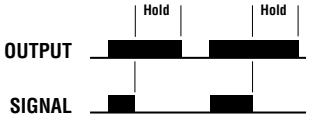
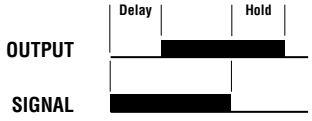
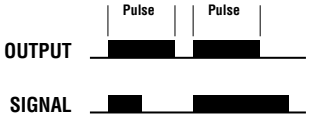
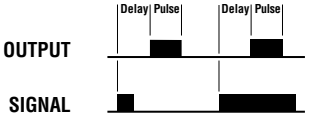
MAXI-BEAM Logic Modules



MAXI-BEAM logic module (top), and programming ring for logic (bottom)

- Logic modules stack between the sensor head and power block to add output timing control
- Supplied with a programming ring for selection of eight different combinations of time range and logic function
- Model RLM5 is programmable for ON-delay, OFF-delay, or ON/OFF-delay timing
- Model RLM8 is programmable for One-shot and Delayed One-shot pulse timing
- Both models feature multi-turn, clutched controls for accurate timing adjustments
- Once programmed by orientation of the programming ring, the logic module may be rotated on the power block in 90° increments to position the timing adjustments for the most convenient access
- Rugged construction, with reinforced thermoplastic polyester housing and epoxy-encapsulated circuitry

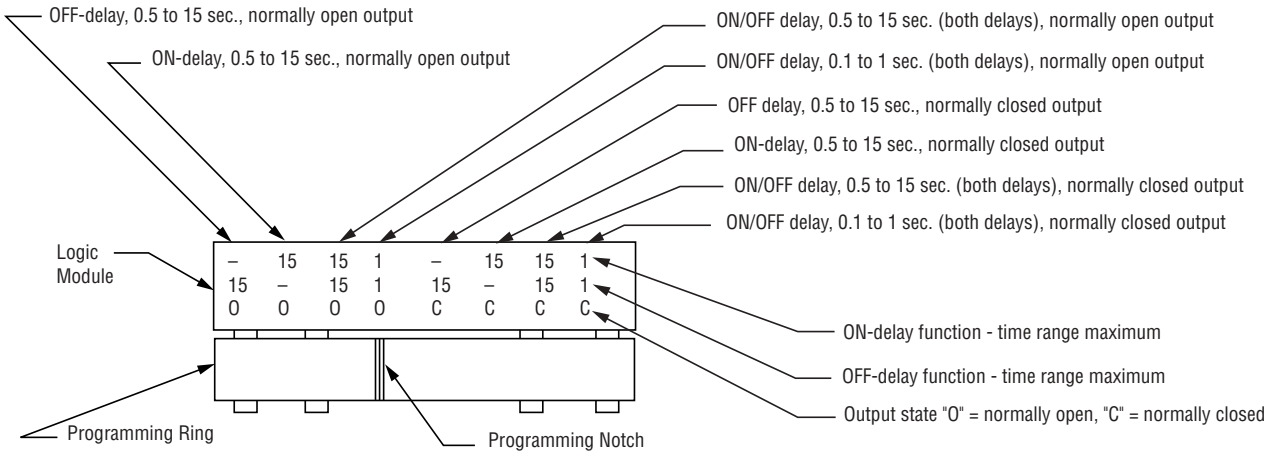
MAXI-BEAM Logic Modules

Model	Timing Function	Timing Range	Timing Diagram
RLM5	On-delay	0.1 to 1 second; 0.5 to 15 seconds	
	Off-delay		
	On/Off -delay		
RLM8	One-shot	0.01 to 0.1 second; 0.1 to 1 second; 0.5 to 15 seconds	
	Delayed One-shot		

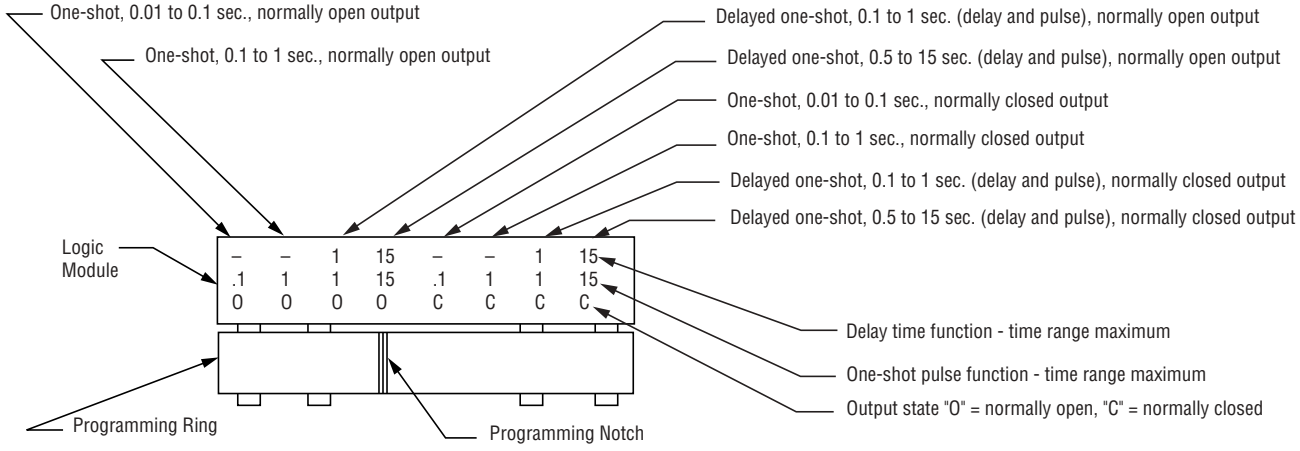
MAXI-BEAM Logic Modules Specifications

Response Time	RLM5: add sensor response delay of approximately 2% of maximum OFF-DELAY time RLM8: no added response time for ONE-SHOT mode
Timing Repeatability	±2% of maximum time of the selected range, assuming conditions of constant operating temperature and power supply voltage
Timing Range	15 second ranges: 0.5 to 15 seconds 1 second ranges: 0.1 to 1 second 0.1 second ranges: 0.01 to 0.1 second
Adjustments	Two 15-turn clutched potentiometers with brass element, accessible from outside of logic modules, under o-ring gasketed cover screws
Construction	Molded thermoplastic polyester with epoxy-encapsulated circuitry, quad-ring gasketed
Environmental Rating	Meets NEMA standards 1, 2, 3, 3S, 4, 12, and 13; IEC IP66 when assembled with sensor head
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	

RLM5 Program Definition Diagram



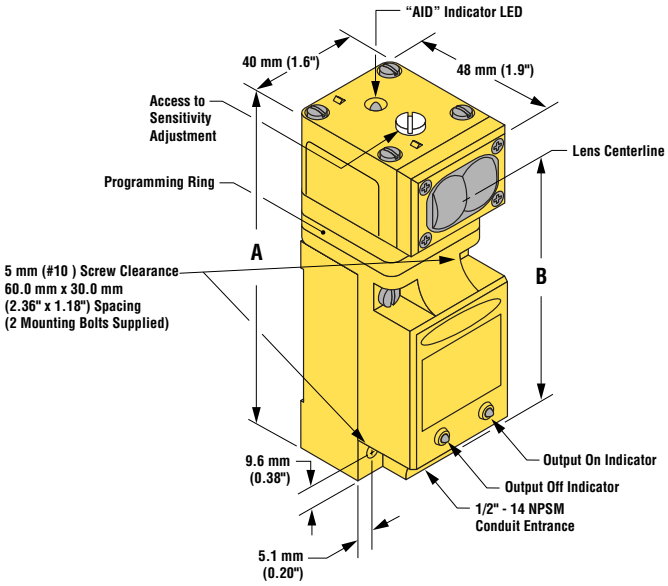
RLM8 Program Definition Diagram



MAXI-BEAM Dimensions

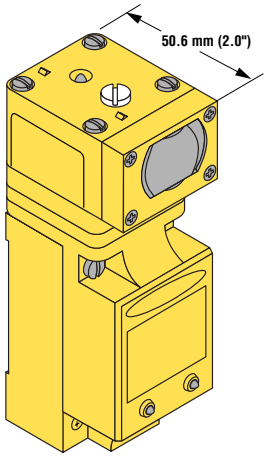
Assembled MAXI-BEAM Sensor with Standard Lens

Opposed, Retroreflective & Diffuse (model suffix E,R, ESR, RSR, LV, LVAG, D & DSR)

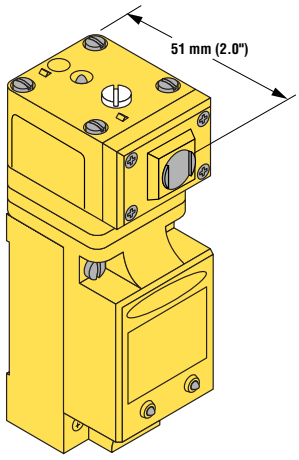


Dimension A	Dimension B	Configuration
114 mm (4.5")	100 mm (3.9")	Without Logic Module
127 mm (5.0")	112 mm (4.4")	With Logic Module

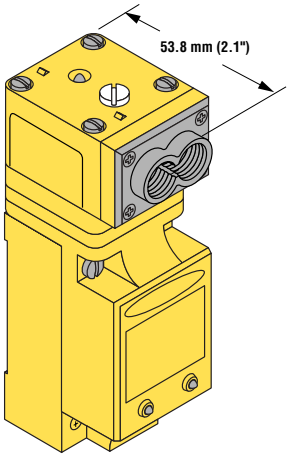
Convergent Sensing Mode (model suffix C & CV)



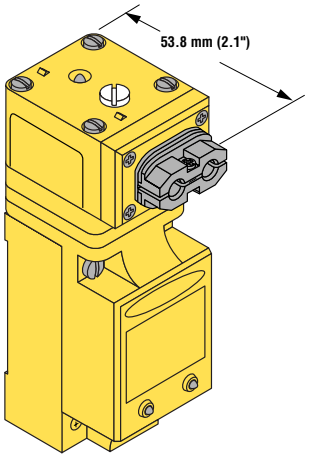
Fixed-field Mode (model suffix FF50 & FF100)



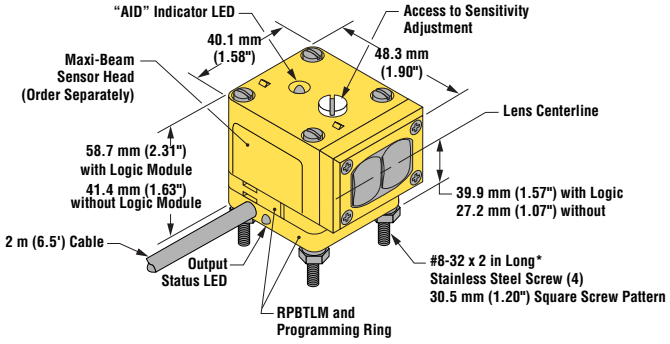
Glass Fiber Optic (model suffix F, FV, EF & RF)



Plastic Fiber Optic (model suffix FP)



Assembled MAXI-BEAM sensor w/ RPBTLM DC Power Block



* Note: #8-32 x 2 1/2" long screws are also supplied with RPBTLM for assembly when a logic module is added.

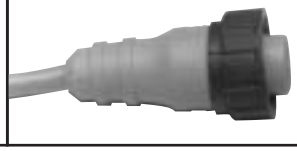
Replacement Lens Assemblies

MAXI-BEAM lens assemblies are field-replaceable. In addition, some lenses may be used to convert from one sensing mode to another, or to change the sensing range of a particular sensor. Upper cover assemblies include lens, replacement bezel, o-ring and stainless steel screws. The possible conversions are listed in the table below.

Model	Description	Possible Sensing Mode or Range Changes	
RUC-L	Replacement lens for RSBE, RSBR, RSBLV, & RSBD	Change RSBLVAG to RSBLV, RSBCV to RSBLV & RSBDSR to RSBD	
RUC-AG	Replacement lens for RSBLVAG	Change RSBLV to RSBLVAG	
RUC-DSR	Replacement lens for RSBDSR, ESR & RSR	Change RSBD to RSBDSR & RSBF to RSBDSR	
RUC-C	Replacement lens for RSBC & CV	Change RSBLV to RSBCV	
RUC-F	Replacement lens for RSBF & FV	Change RSBD to RSBF & RSBDSR to RSBF	
RUC-FP	Replacement lens for RSBFP		

Quick-Disconnect (QD) Cables and Connectors

Connector MBC-4 adapts any MAXI-BEAM sensor assembly to accept 4-wire mini-style quick-disconnect cables.

Style	Model	Length	Connector	
4-Pin Mini	**Connector to install in RWB4 wiring base**	Wire Length: 300 mm (12")	Straight	
	MBC-4			
	Mating Cables	Cable Length: 2 m (6.5') 4 m (12') 9 m (30')		
	MBCC-406 MBCC-412 MBCC-430			

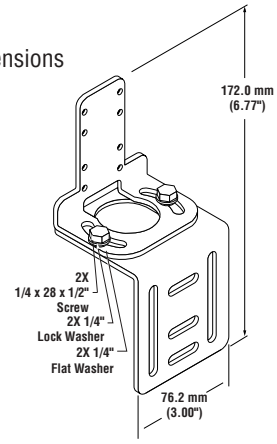
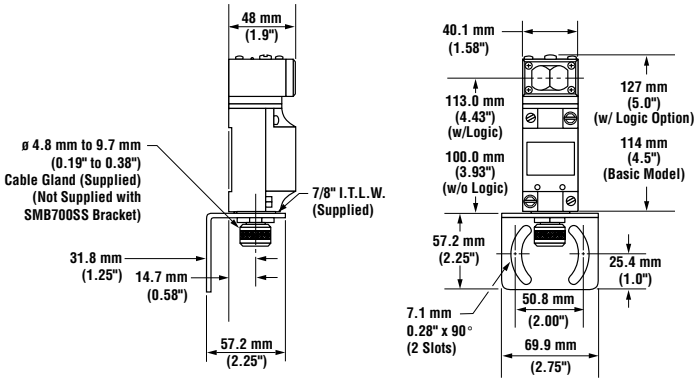
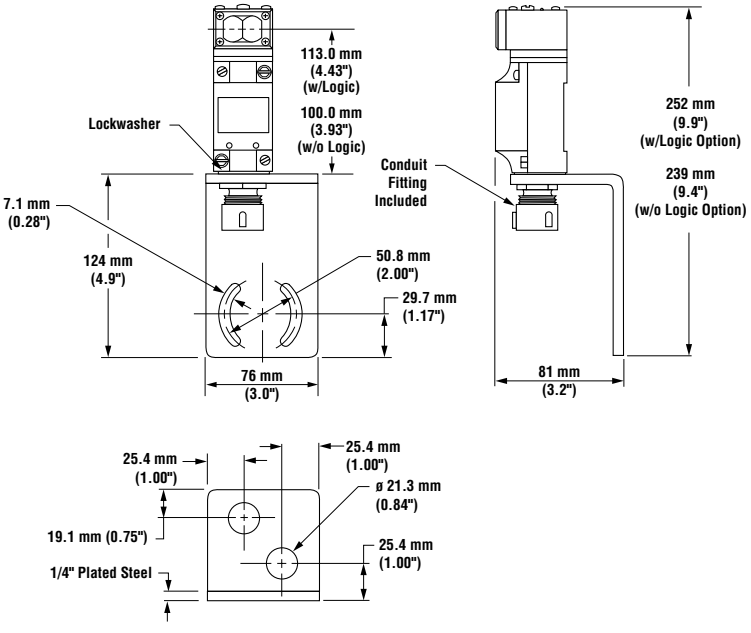
Cable Gland Assembly

Model	Description	
RF1-2NPS	• Cable gland assembly for MAXI-BEAMs • Includes cord grips for 2.5 to 10 mm (0.1 - 0.4 in) diameter cable • Bracket lockwasher is also included	

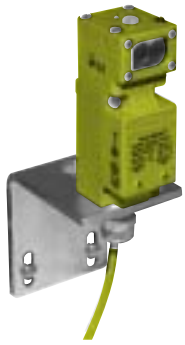
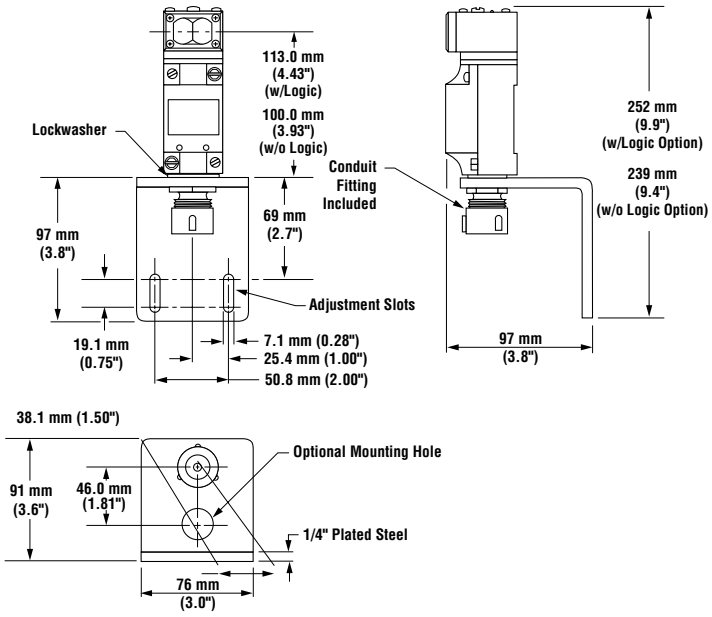
Cable Protector

Model	Description	
HF1-2NPS	• Flexible black nylon cable protector • Includes a neoprene gland that compresses around the MAXI-BEAM cable to provide an additional seal against moisture • Resistant to gasoline, alcohol, oil, grease, solvents and weak acids • Working temperature range of -30° to +100°C (-22° to +212°F)	

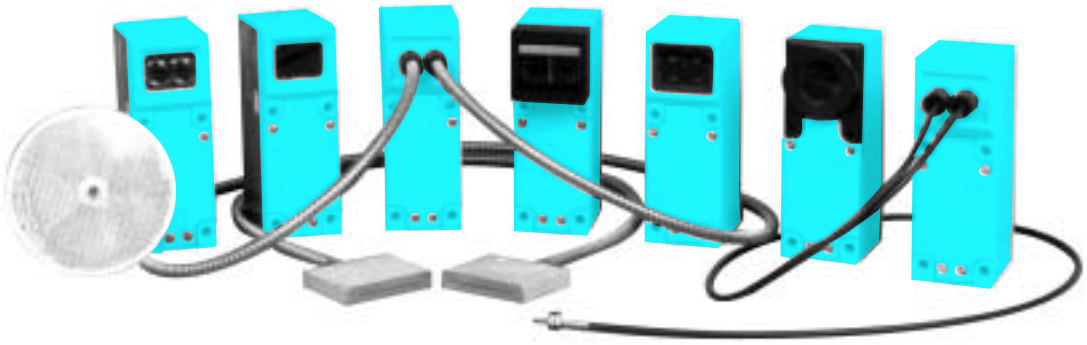
Mounting Brackets

Model	Description	Dimensions
SMB30UR 	• 2-piece universal swivel bracket for limit-switch style sensors • 300 series stainless steel • Includes stainless steel swivel locking hardware	NOTE: See p. 746 for additional dimensions 
SMB700 **SMB700F** **SMB700SS** 	SMB700: • Right angle, 11-gauge, zinc plated steel, 2-axis mounting bracket supplied with cable gland assembly and lockwasher SMB700F; • Flat, single-axis version of SMB700, sold without hardware SMB700SS: • 11-gauge , stainless steel version of SMB700 sold without hardware	
SMB700M 	• Heavy-duty 6 mm (0.25") zinc plated steel bracket • Allows MULTI-BEAM to retrofit to installations of MICRO-SWITCH models MLS8 or MLS9 sensors • Includes cable gland and lockwasher	

Mounting Brackets

Model	Description	Dimensions
SMB700P 	• Heavy-duty 6 mm (0.25") zinc plated steel bracket • Allows MULTI-BEAM to retrofit to installations of PHOTOSWITCH series 42RLU or 42RLP sensors • Includes cable gland and lockwasher	

NOTES:



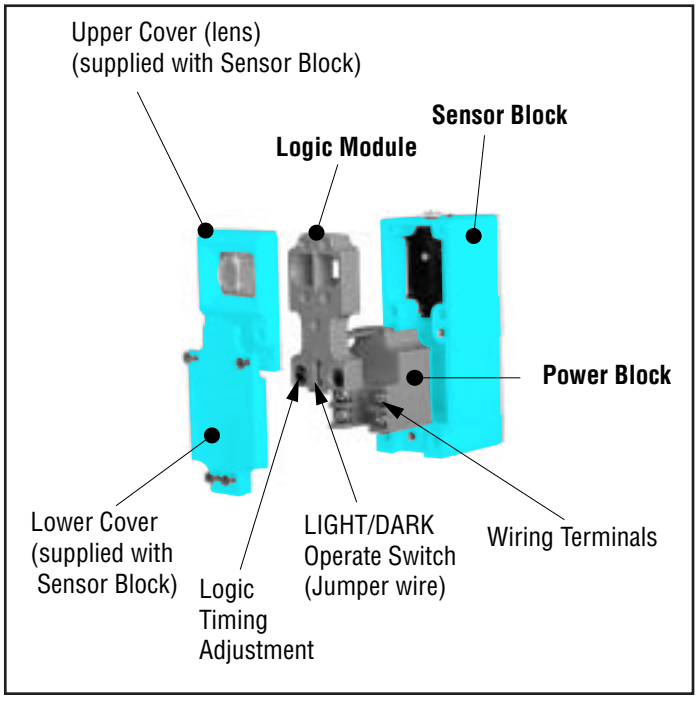
MULTI-BEAM® Sensors

(Most models, exceptions are noted)

MULTI-BEAM sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

Selection of Components for MULTI-BEAM Sensors

MULTI-BEAM sensors are modular self-contained photoelectric sensors which allow you to create a custom sensor exactly suited for the application.



STEP 1

Determine which family of MULTI-BEAM sensors is appropriate for the application: 3- and 4-wire, or 2-wire

STEP 2

Choose a sensor block for the required sensing mode

STEP 3

Choose a power block for the required sensor power (ac or dc) and interface

STEP 4

Choose a logic module*

STEP 5

Simply plug components together without interwiring to create a complete self-contained photoelectric sensor that is tailored to your exact sensing needs

MULTI-BEAM modular components are sold separately. The three modular components, plus the lenses, are field-replaceable.

**NOTE: Opposed mode emitters do not require a logic module*

MULTI-BEAM 3- & 4-Wire Sensor Blocks

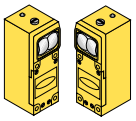
- Offering the broadest selection of sensing response and interfacing options available in any photoelectric product line
- All models (except ambient light receivers) feature Banner's exclusive† AID™ (Alignment Indicating Device) circuit which pulses the alignment LED at a rate proportional to the received light signal strength
- Select a sensor block, power block and logic module to create a customized sensor exactly suited to the application (NOTE: Opposed mode emitters do not require a logic module)
- Select standard 1 millisecond output response sensor blocks, or high power models with 10 millisecond response
- Choose a power block to match virtually any requirement for sensor power and sensor output interface
- Logic modules are available for straight-through on/off output response or for a wide variety of output timing control functions

† U.S. Patent #4356393

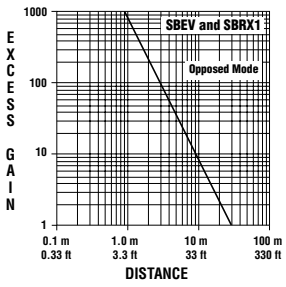
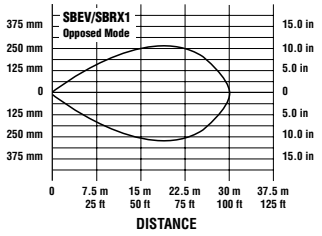
MULTI-BEAM Glass Fiber Optic emitter and receiver

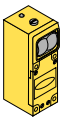
MULTI-BEAM 3- & 4-Wire Sensor Block Sensing Mode Options

Visible Red, 650 nm



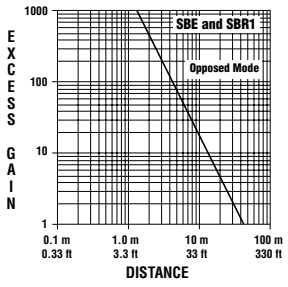
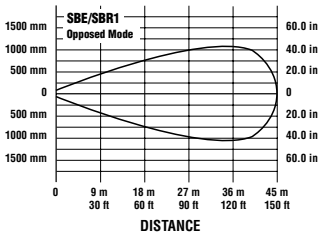
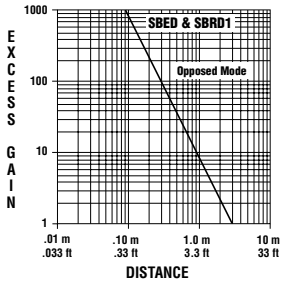
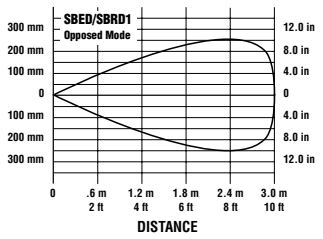
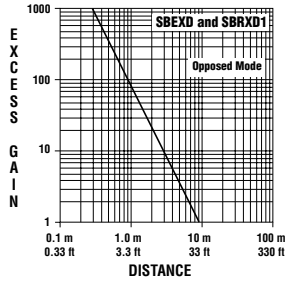
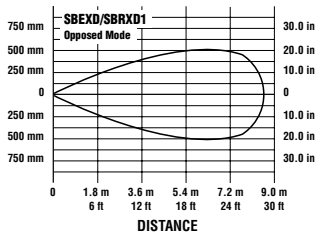
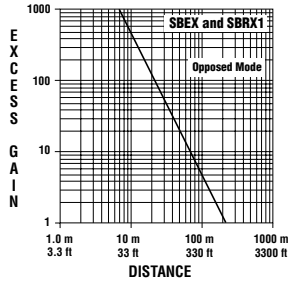
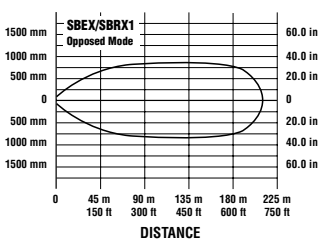
MULTI-BEAM 3- & 4-Wire Opposed Mode Emitter (E) and Receiver (R)

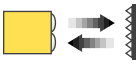
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
SBEV **SBRX1**	30 m (100')	10 ms on/off	0.1 ms		Effective Beam: 25 mm 



See Sensing Beam Information Below

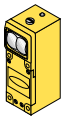
MULTI-BEAM 3- & 4-Wire Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
High Speed - Infrared 940 nm					
SBE **SBR1**	45 m (150')	1 ms on/off	0.03 ms		Effective Beam: 25 mm 
High Speed, Narrow Beam - Infrared 880 nm					
SBED **SBRD1**	3 m (10')	1 ms on/off	0.03 ms		Effective Beam: 3.5 mm 
High Power, Wide Beam Angle - Infrared 880 nm					
SBEXD **SBRXD1**	9 m (30')	10 ms on/off	0.7 ms		Effective Beam: 3.5 mm 
High Power, Long Range - Infrared 940 nm					
SBEX **SBRX1**	200 m (700')	10 ms on/off	0.7 ms		Effective Beam: 25 mm 

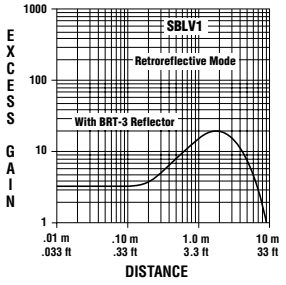
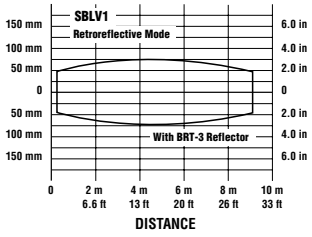
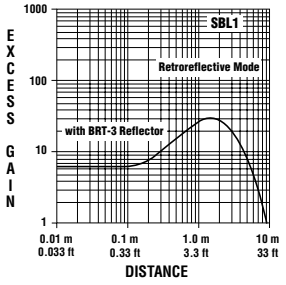
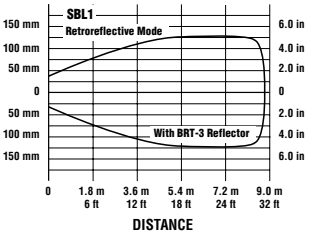
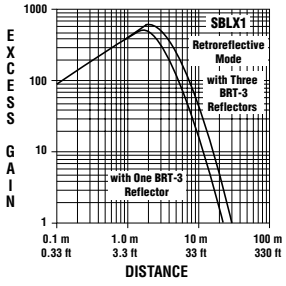
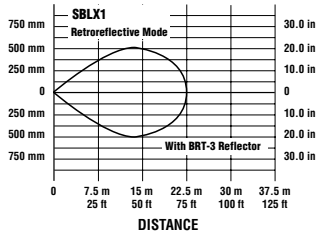


See Sensing Beam Information Below

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use.
See page 722 for more information.



MULTI-BEAM 3- & 4-Wire Non-Polarized Retroreflective Mode

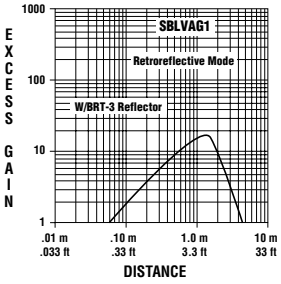
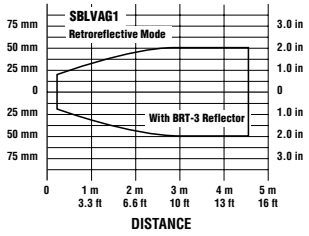
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
High Speed - Visible Red 650 nm					
SBLV1	0.15 - 9 m (6" - 30')	1 ms on/off	0.3 ms		
High Speed - Infrared 940 nm					
SBL1	25 mm - 9 m (1" - 30')	1 ms on/off	0.3 ms		
High Power, Long Range - Infrared 880 nm					
SBLX1	3 - 22 m (10 - 75') w/one BRT-3 target 3 - 30 m (10 - 100') w/3 BRT-3 targets	10 ms on/off	1.5 ms		

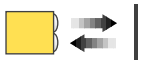
NOTE: Use polarized sensor block when shiny objects will be sensed. Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

P

Visible Red, 650 nm

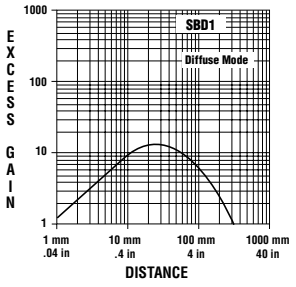
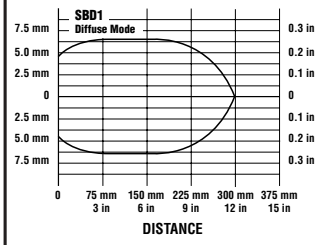
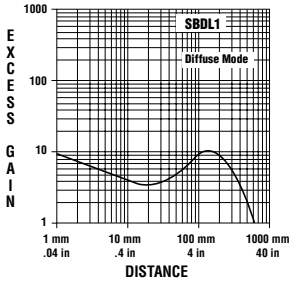
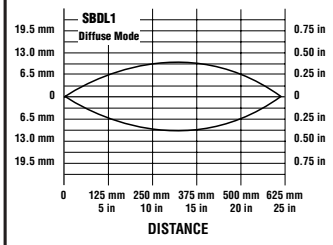
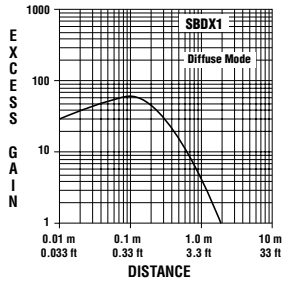
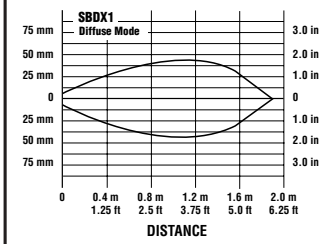
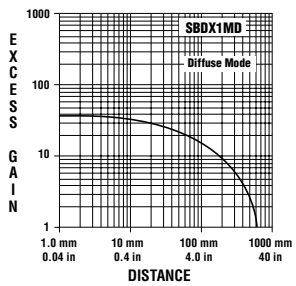
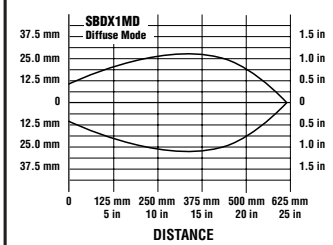
MULTI-BEAM 3- & 4-Wire Polarized Retroreflective Mode

Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
SBLVAG1	0.3 - 4.5 m (12" - 15')	1 ms on/off	0.3 ms		

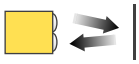


See Sensing Beam Information Below

MULTI-BEAM 3- & 4-Wire Diffuse Mode

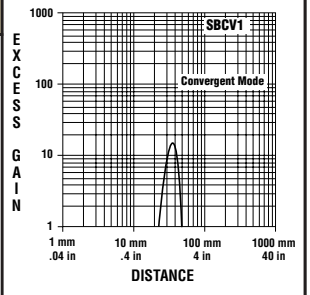
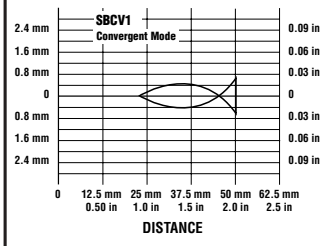
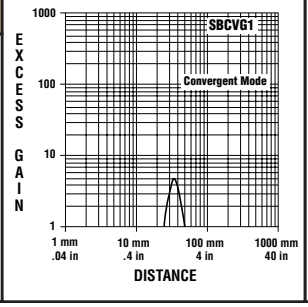
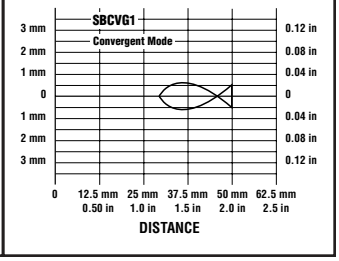
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
High Speed - Infrared 940 nm					
SBD1	300 mm (12")	1 ms on/off	0.3 ms		
Medium Range - Infrared 940 nm					
SBDL1	600 mm (24")	1 ms on/off	0.3 ms		
High Power, Long Range - Infrared 880 nm					
SBDX1	1.8 m (6')	10 ms on/off	1.5 ms		
Wide Beam Angle - Infrared 880 nm					
SBDX1MD*	600 mm (24")	10 ms on/off	1.5ms		

* Good choice for sensing clear materials

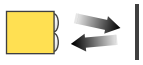


See Sensing Beam Information Below

MULTI-BEAM 3- & 4-Wire High Speed Convergent Mode

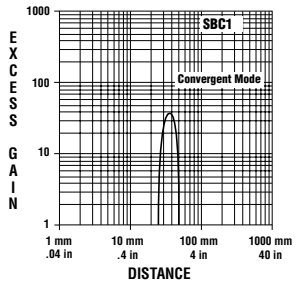
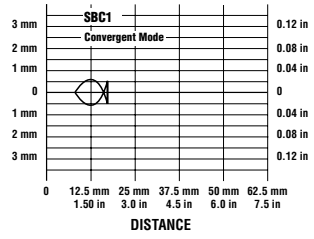
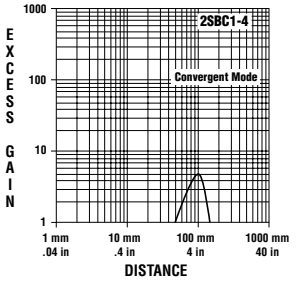
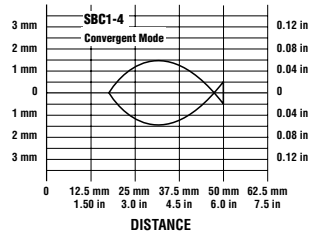
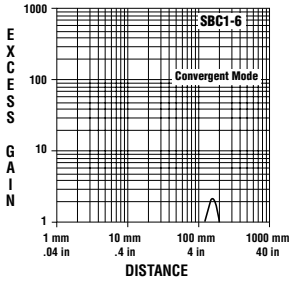
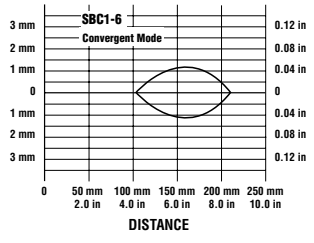
Models	Focus	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
Visible Red 650 nm					
SBCV1	38 mm (1.5") Spot Size at Focus: 1.5 mm (0.06")	1 ms on/off	0.3 ms		
Visible Green 560 nm*					
SBCVG1	38 mm (1.5") Spot Size at Focus: 3.0 mm (0.12")	1 ms on/off	0.3 ms		

* Recommended for color mark sensing

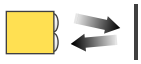


Infrared, 940 nm

MULTI-BEAM 3- & 4-Wire High Speed Convergent Mode

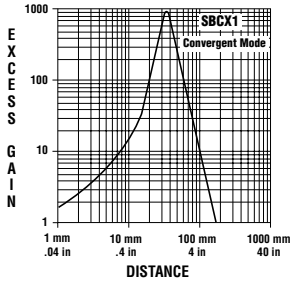
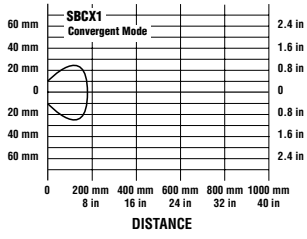
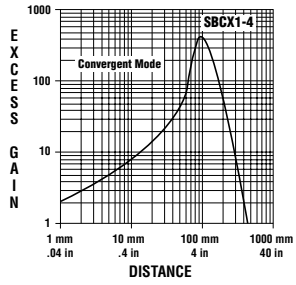
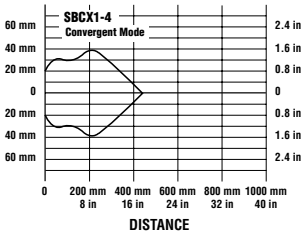
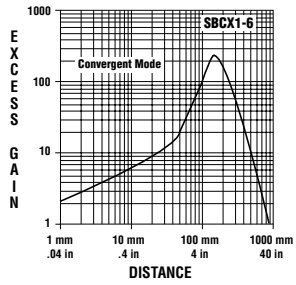
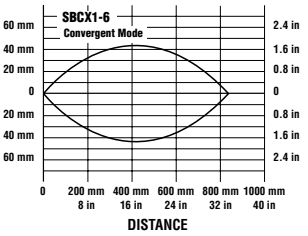
Models	Focus	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
SBC1	38 mm (1.5")	1 ms on/off	0.3 ms		
SBC1-4	100 mm (4")	1 ms on/off	0.3 ms		
SBC1-6	150 mm (6")	1 ms on/off	0.3 ms		

High power convergent models are able to sense objects with low reflectivity.

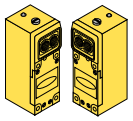


Infrared, 880 nm

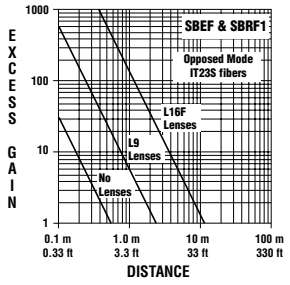
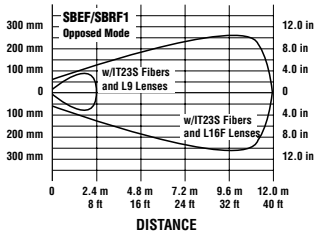
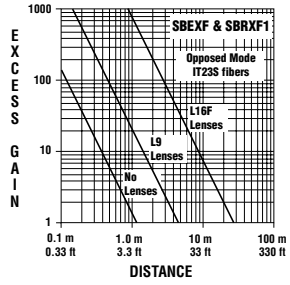
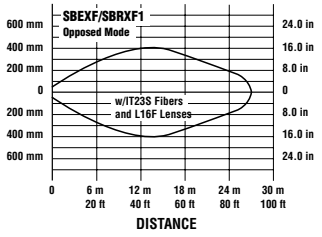
MULTI-BEAM 3- & 4-Wire High Power Convergent Mode

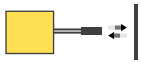
Models	Focus	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
SBCX1	38 mm (1.5")	10 ms on/off	1.5 ms		
SBCX1-4	100 mm (4")	10 ms on/off	1.5 ms		
SBCX1-6	150 mm (6")	10 ms on/off	1.5 ms		

Infrared, 880 nm



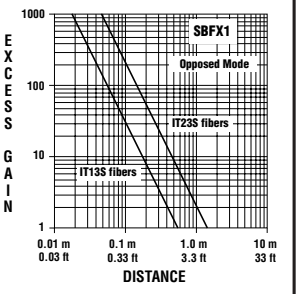
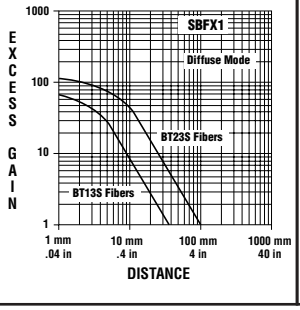
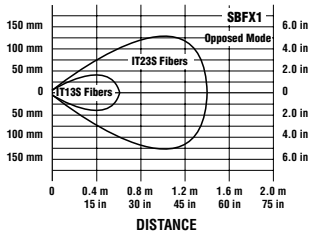
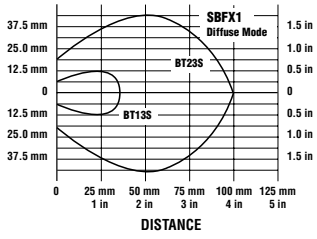
MULTI-BEAM 3- & 4-Wire Glass Fiber Optic Emitter (E) and Receiver (R)

Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
High Speed					
SBEF **SBRF1**	Range varies with fiber optics used	1 ms on/off	0.03 ms		
High Power					
SBEXF **SBRXF1**	Range varies with fiber optics used	10 ms on/off	0.7 ms		

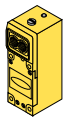


Infrared, 880 nm

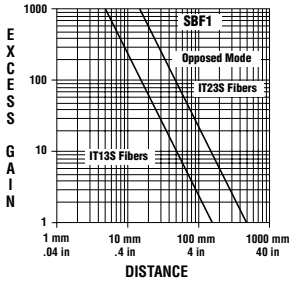
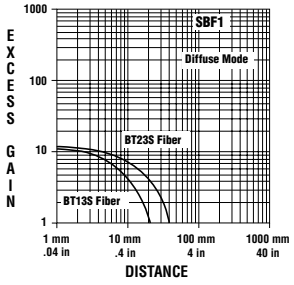
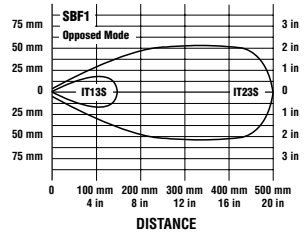
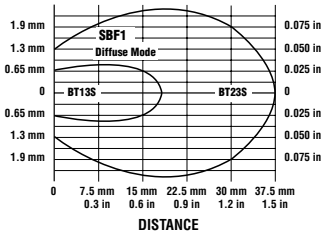
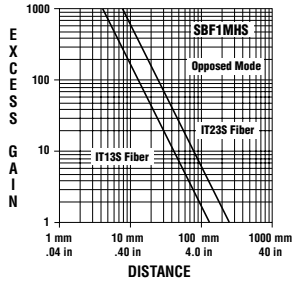
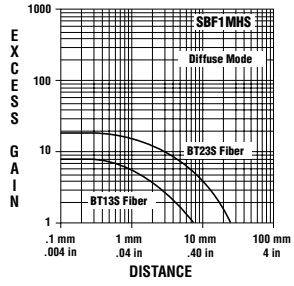
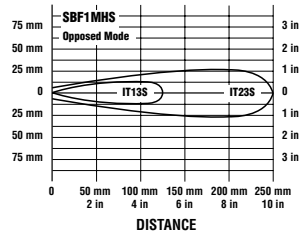
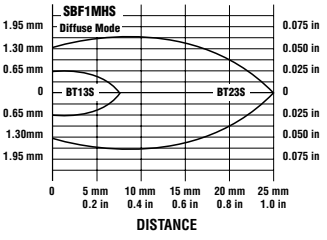
MULTI-BEAM 3- & 4-Wire High Power Glass Fiber Optic

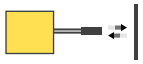
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
SBFX1	Range varies by sensing mode and fiber optics used	10 ms on/off	1.5 ms	 	 

Infrared, 940 nm



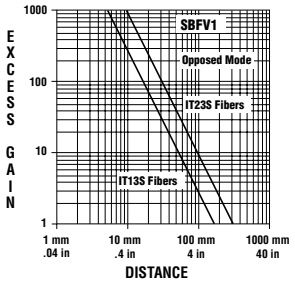
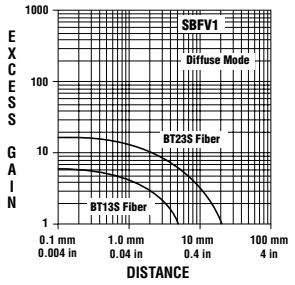
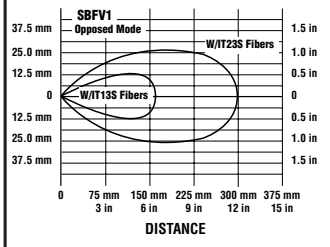
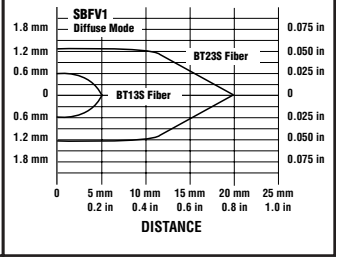
MULTI-BEAM 3- & 4-Wire High Glass Fiber Optic

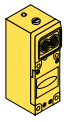
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
High Speed					
SBF1	Range varies by sensing mode and fiber optics used	1 ms on/off	0.3 ms	 	 
Very High Speed					
SBF1MHS	Range varies by sensing mode and fiber optics used	0.3 ms on/off	0.1 ms	 	 

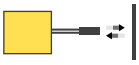


Visible Red, 650 nm

MULTI-BEAM 3- & 4-Wire Glass Fiber Optic

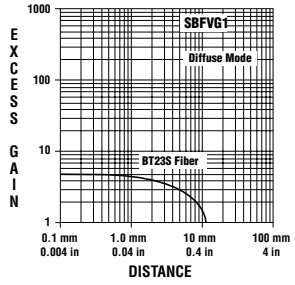
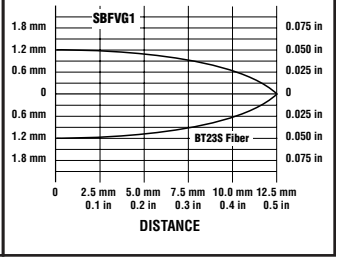
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
SBFV1	Range varies by sensing mode and fiber optics used	1 ms on/off	0.3 ms	 	 





Visible Green, 560 nm for color mark sensing

MULTI-BEAM 3- & 4-Wire Glass Fiber Optic

Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
SBFVG1	Range varies with fiber optics used	1 ms on/off	0.3 ms		

MULTI-BEAM 3- & 4-Wire Sensor Block Specifications

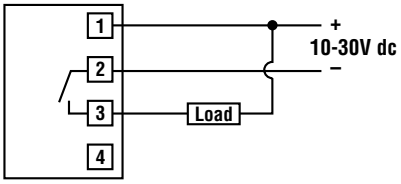
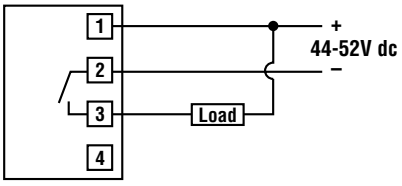
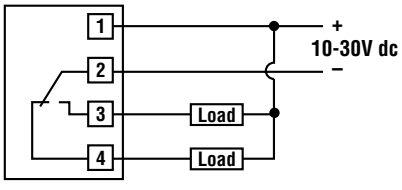
Supply Voltage and Current	Supplied by 3- or 4-wire power block
Output Response Time	1 millisecond ON and OFF, except high gain models with "X" suffix which are 10 milliseconds ON and OFF. Response time and repeatability specifications are independent of signal strength.
Repeatability	See individual sensor mode charts
Adjustments	Located on top of sensor block beneath o-ring gasketed screw cover. 15-turn clutched control (rotate clockwise to increase gain)
Indicators	Red LED on top of sensor block. Banner's exclusive, patented Alignment Indicating Device (AID™) circuit lights the LED whenever the sensor detects its own modulated light source, and pulses the LED at a rate proportional to the received light level (except opposed mode emitters)
Construction	Reinforced thermoplastic polyester, totally encapsulated housing and stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 3, 12, and 13; IEC IP54
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	

MULTI-BEAM 3- & 4-Wire Power Blocks

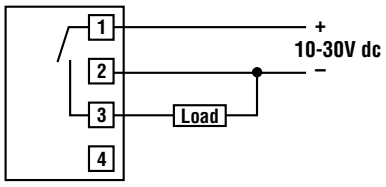
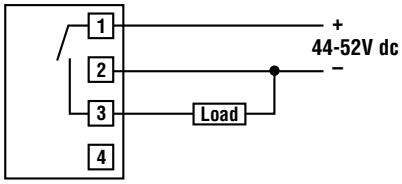
DC (left) and AC (right) power blocks shown
DC power blocks have gray housings;
AC models are red

- MULTI-BEAM 3- & 4-wire power blocks provide regulated power to the sensor block and logic module, plus a solid-state output switch
- Choose from several operating voltages, and then determine the most appropriate output device for the sensor interface
- Power block models are available without output circuitry for powering opposed mode emitters
- Power blocks slide easily into the wiring area of any sensor block and interconnect, without wiring, when the logic module is installed
- Wiring connections are made to heavy-duty screw terminals which accept up to #14 gauge wire - no wiring lugs are necessary
- DC power blocks are color-coded gray; all 3- and 4-wire ac power blocks are red

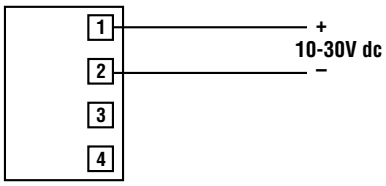
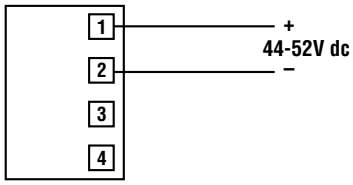
MULTI-BEAM 3- & 4-Wire DC Power Blocks

Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
PBT	10-30V dc <60 mA	SPST NPN (Sinking)	30V dc max 250 mA max	<1 V dc	<10 µA	
PBT48*	44-52V dc <60 mA	SPST NPN (Sinking)	52V dc max 250 mA max	<1 V dc	<1 µA	
PBT2*	10-30V dc <60 mA	SPDT NPN (Sinking)	30V dc max 250 mA max (each output)	<1 V dc	<10 µA	

MULTI-BEAM 3- & 4-Wire DC Power Blocks

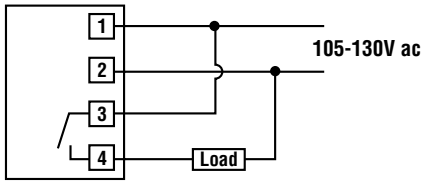
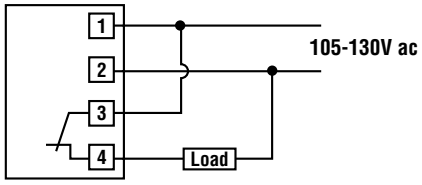
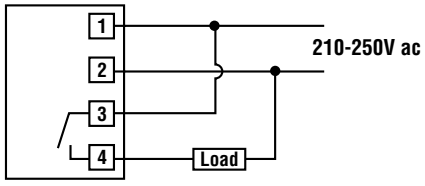
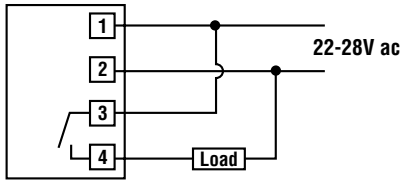
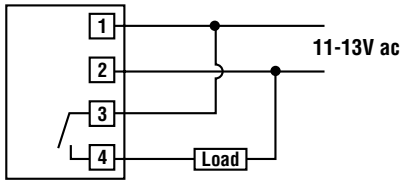
Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
PBP*	10-30V dc <60 mA	SPST PNP (Sourcing)	30V dc max 250 mA max	<1 V dc	<10 µA	
PBP48*	44-52V dc <60 mA	SPST PNP (Sourcing)	52V dc max 250 mA max	<1 V dc	<10 µA	

MULTI-BEAM 3- & 4-Wire DC Power Blocks for Opposed Emitter Sensor Blocks

Models	Supply Voltage	Hookup Diagram
PBT-1	10-30V dc <60 mA	
PBT48-1*	44-52V dc <60 mA	

* NOTE: These models do not carry UL or CSA approval

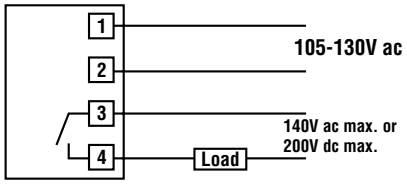
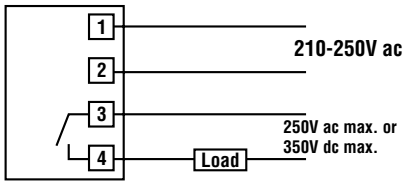
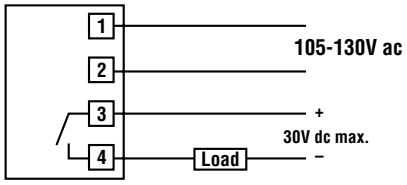
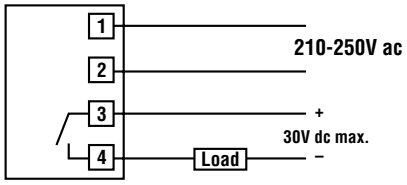
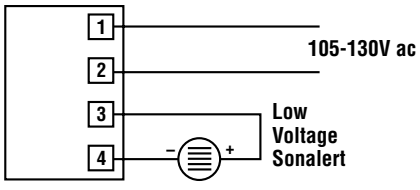
MULTI-BEAM 3- & 4-Wire AC Power Blocks

Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
PBA	105-130V ac	SPST Solid-state	250V ac max 750 mA max	<2.5V ac	<100 µA	
PBAQ[1]*	105-130V ac	SPST - N.C. Solid-state	250V ac max 750 mA max	<2.5V ac	<100 µA	
PBB	210-250V ac	SPST Solid-state	250V ac max 750 mA max	<2.5V ac	<100 µA	
PBD	22-28V ac	SPST Solid-state	250V ac max 750 mA max	<2.5V ac	<100 µA	
PBD-2*	11-13V ac	SPST Solid-state	250V ac max 750 mA max	<2.5V ac	<100 µA	

[1] NOTE: Power block model PBAQ is not compatible with logic module models LM5 or LM5-14

* NOTE: These models do not carry UL or CSA approval

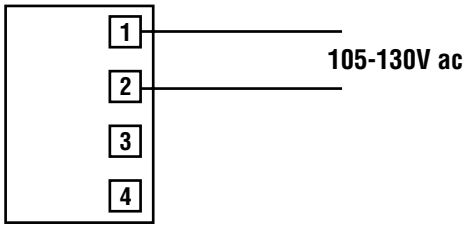
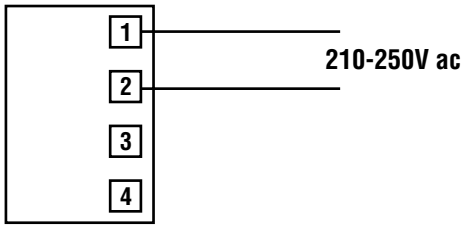
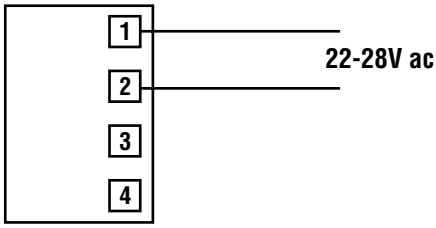
MULTI-BEAM 3- & 4-Wire AC Power Blocks

Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
PBAT	105-130V ac	SPST Isolated Solid-state	140V ac max or 200V dc max 100 mA max	<3V	<100 µA	
PBBT	210-250V ac	SPST Isolated Solid-state	250V ac max or 350V dc max 100 mA max	<3V	<100 µA	
PBOL[2]	105-130V ac	Optically - SPST isolated Solid-state	30V dc max 100mA max	<0.2V dc	<10 µA	
PBOBL[2]	210-250V ac	Optically - SPST isolated Solid-state	30V dc max 100 mA max	<0.2V dc	<10 µA	
PBAM[3]	105-130V ac	8V dc Sourcing	8V dc at 8 mA max	N/A	<10 µA	

[2] NOTE: The output of power block models PBOL and PBOBL is compatible with TLL circuit inputs

[3] NOTE: The output of power block model PBAM is designed to drive a low voltage piezoelectric annunciator

MULTI-BEAM 3- & 4-Wire AC Power Blocks for Opposed Emitter Sensor Blocks

Models	Supply Voltage	Hookup Diagram
PBA-1	105-130V ac	
PBB-1	210-250V ac	
PBD-1*	22-28V ac	

MULTI-BEAM 3- & 4-Wire AC and DC Power Block Specifications

Supply Voltage and Current	See individual model specifications
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	See individual model specifications
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	Add 8.3 milliseconds to the sensor block off-time response when switching ac loads
Construction	Reinforced thermoplastic polyester housing, totally epoxy-encapsulated circuitry
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE, CSA® [1], UL LISTED [1]

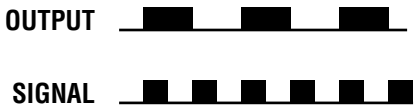
[1] The following power block models do not have UL or CSA approval: PBT2, PBT48,PBT48-1, PBD-1, PBP, PBP48, PBD-2 and PBAQ

MULTI-BEAM 3- & 4-Wire Logic Modules

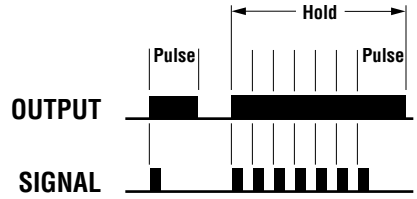
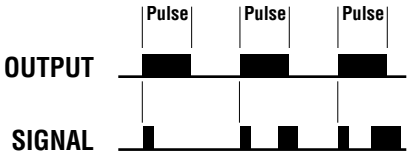
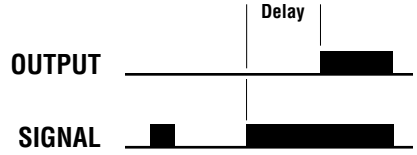
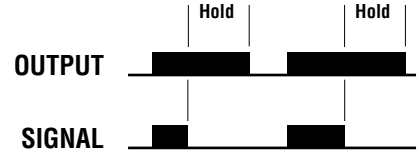
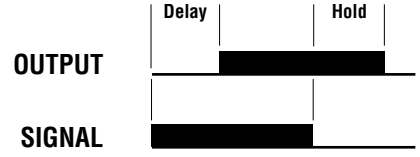
- The logic module interconnects the power block and sensor block, both electrically and mechanically
- Logic modules simply slide into the sensor block, after the power block is installed, to interconnect the three components, without interwiring, using a blade-and-socket connector concept
- Logic modules provide light/dark operate selection (except models LM1 and LM2) and 14 models offer a full selection of output timing and logic control; timing functions are adjustable
- Totally-encapsulated electronics and gold-plated connectors assure high reliability, even in challenging sensing environments
- All 3- and 4-wire logic modules are color-coded red

All 3- and 4-wire logic modules are color-coded red.

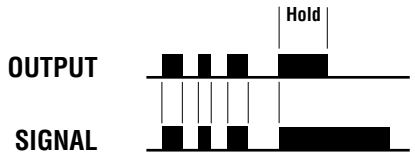
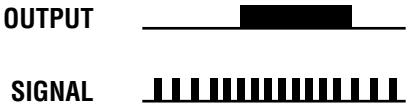
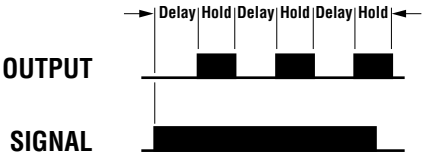
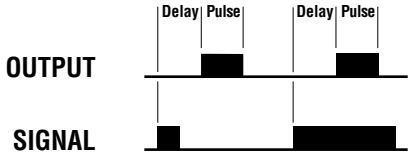
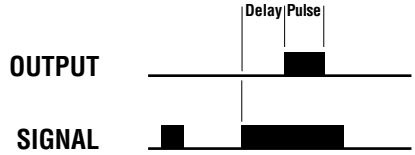
MULTI-BEAM 3- & 4-Wire Logic Modules

Models	Timing Function	Timing Range	Timing Diagram
LM1	On/Off	None - output follows input Light operate, only	
LM2	Alternate Action	None - Light operate, only	
LM3	On/Off	None - output follows input	

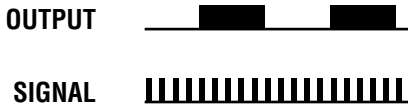
MULTI-BEAM 3- & 4-Wire Logic Modules

Models	Timing Function	Timing Range	Timing Diagram
LM4-2	One-shot Retriggerable	0.1 to 1 second	
LM4-2NR	One-shot Non-retriggerable	0.1 to 1 second	
LM5	On-delay	1.5 to 15 seconds	
LM5R	Off-delay	1.5 to 15 seconds	
LM5-14	On-delay and Off-delay	1.5 to 15 seconds (for both delays)	

MULTI-BEAM 3- & 4-Wire Logic Modules

Models	Timing Function	Timing Range	Timing Diagram
LM5T	Limit timer (energy conservation timer)	1.5 to 15 seconds	
LM6-1	Rate sensor (Overspeed/Under-speed)	0.05 to 1.0 seconds per pulse (60 to 1200 pulses per minute)	
LM8	Repeat cycler	1.5 to 15 seconds (for both delay and hold)	
LM8-1	Delayed One-shot	1.5 to 15 seconds (for both delay and one-shot)	
LM8A	On-delay and One-shot	1.5 to 15 seconds (for both delay and one-shot)	

MULTI-BEAM 3- & 4-Wire Logic Modules

Models	Timing Function	Timing Range	Timing Diagram
LM10	Divide by ten (Alternate action)	None	
LMT†	Test module	None- provides sensor diagnostics	

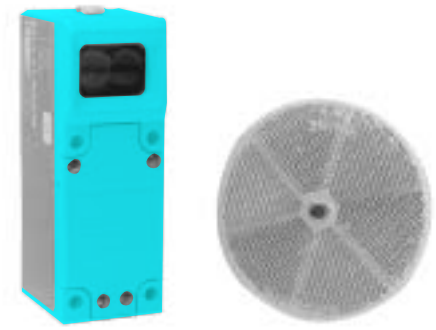
†May be used with all 2-, 3- and 4-wire MULTI-BEAM sensors to check operation of sensor block and power block

MULTI-BEAM 3- & 4-Wire Logic Modules Specifications

Response Time	Response time will be that for the sensor block plus the programmed delay (if the logic includes a delay function)
Timing Repeatability	±2% of maximum range under constant power supply and temperature conditions; ±5% of maximum range under all conditions of supply voltage and temperature
Timing Range	Useful range is from maximum time down to 10% of maximum (e.g. - from 1 to 0.1 seconds, or from 15 to 1.5 seconds). When timing potentiometer is set fully counterclockwise, time will be approximately 1% of maximum.
Adjustments	One or two single turn potentiometers with slot for blade-type screwdriver adjustment NOTE: when turning time adjustments fully clockwise or counterclockwise, avoid excessive torque to prevent damage to potentiometer. Jumper wire programs output for dark operate. Remove for light operate.
Construction	Molded thermoplastic polyester housing totally epoxy-encapsulated electronic components, and gold-plated blade connectors
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE CSA® UL LISTED

NOTES:

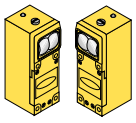
MULTI-BEAM 2-Wire Sensor Blocks



MULTI-BEAM 2-Wire Retroreflective Mode shown

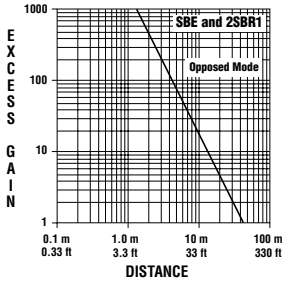
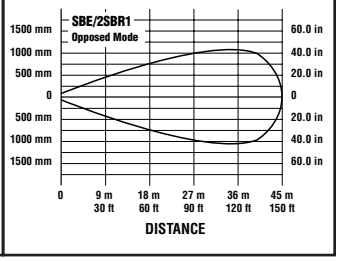
- 2-wire models wire directly in series with an ac load, exactly like a limit switch
- 2-wire sensor blocks have 10-millisecond output response and approximately the same optical performance as equivalent 1-millisecond 3- and 4-wire sensor block models
- The off-state leakage current of 2-wire MULTI-BEAM sensors is less than 1 milliamp; a direct interface to any ac programmable logic controller (PLC) input
- Select a sensor block, power block and logic module to create a customized sensor exactly suited to the application (NOTE: Opposed mode emitters do not require a logic module)

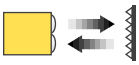
MULTI-BEAM 2-Wire Sensor Block Sensing Mode Options



Infrared, 940 nm

MULTI-BEAM 2-Wire Opposed Mode Emitter (E) and Receiver (R)

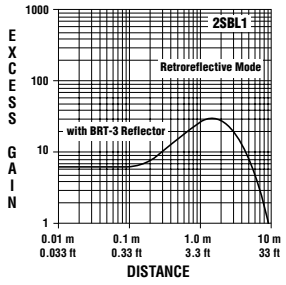
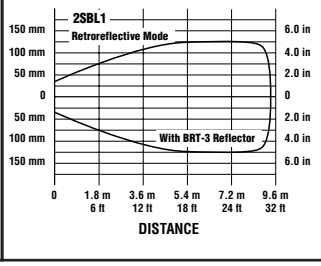
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
SBE **2SBR1**	45 m (150')	10 ms on/off	0.03 ms		Effective Beam: 25 mm 

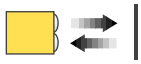


Infrared, 940 nm

NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.

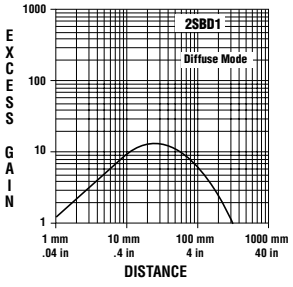
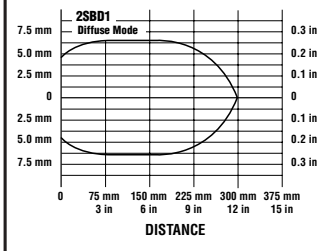
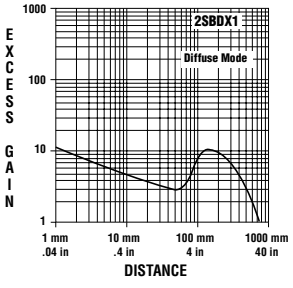
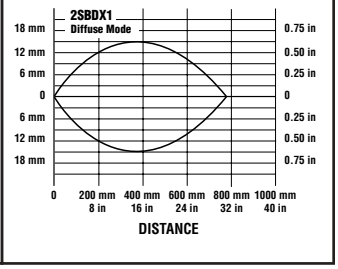
MULTI-BEAM 2-Wire Retroreflective Mode

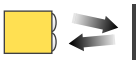
Models	Range	Response	Repeatability of Response	Excess Gain	Beam Pattern
2SBL1	25 mm - 9 m (1" - 30')	10 ms on/off	2.5 ms		



Infrared, 880 nm

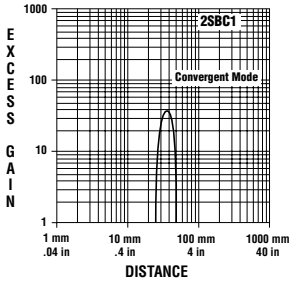
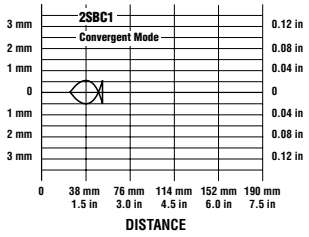
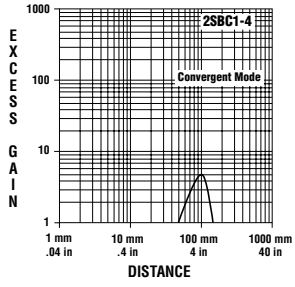
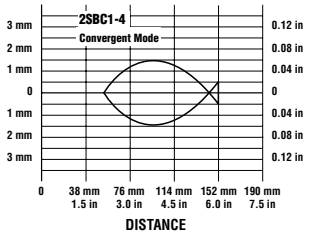
MULTI-BEAM 2-Wire Diffuse Mode

Models	Focus	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
2SBD1	300 mm (12")	10 ms on/off	2.5 ms		
2SBDX1	760 mm (30")	10 ms on/off	2.5 ms		

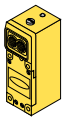


Infrared, 940 nm

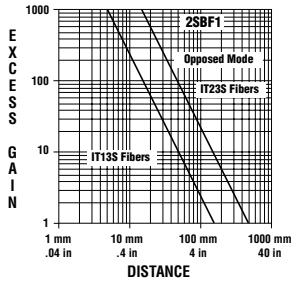
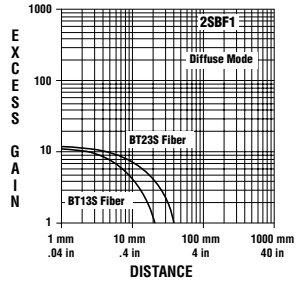
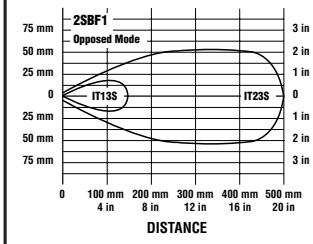
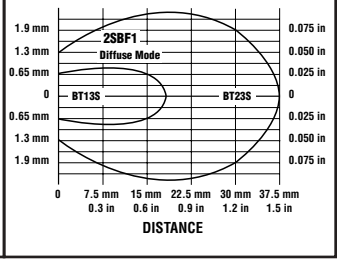
MULTI-BEAM 2-Wire Convergent Mode

Models	Focus	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Performance based on 90% reflectance white test card	
2SBC1	38 mm (1.5")	10 ms on/off	2.5 ms		
2SBC1-4	100 mm (4")	10 ms on/off	2.5 ms		

Infrared, 880 nm



MULTI-BEAM 2-Wire Glass Fiber Optic

Models	Focus	Response	Repeatability of Response	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
2SBF1	Range varies by sensing mode and fiber optics used	10 ms on/off	2.5 ms	 	 

MULTI-BEAM 2-Wire Sensor Block Specifications

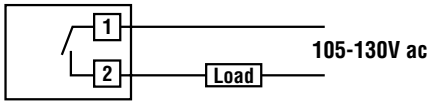
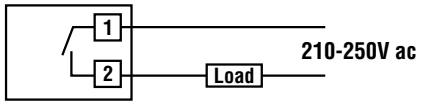
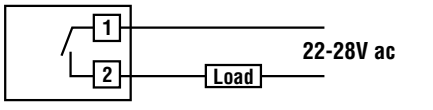
Supply Voltage and Current	Supplied by 2-wire power block
Output Response Time	10 milliseconds ON and OFF NOTE: 100 milliseconds delay on power-up. Response time and repeatability specifications are independent of signal.
Repeatability	See individual sensor mode charts
Adjustments	Located on top of sensor block beneath o-ring gasketed screw cover; 15-turn clutched control (rotate clockwise to increase gain)
Indicators	Red LED on top of sensor block. Banner's exclusive, patented Alignment Indicating Device (AID™) circuit lights the LED whenever the sensor detects its own modulated light source, and pulses the LED at a rate proportional to the received light level (except SBE emitter)
Construction	Reinforced thermoplastic polyester, totally encapsulated housing and stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 3, 12, and 13; IEC IP54
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE

MULTI-BEAM 2-WIRE POWER BLOCKS

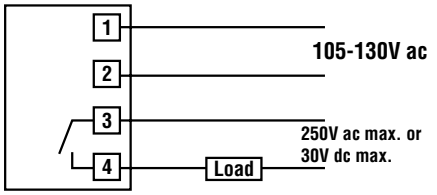
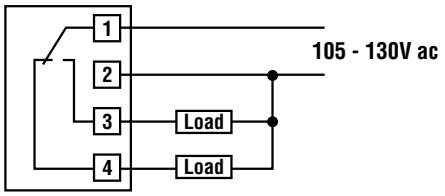
MULTI-BEAM 2-wire ac power blocks are color-coded black

- MULTI-BEAM 2-wire ac power blocks provide regulated power to the sensor block and logic module and a solid-state output switch (except models 2PBR and 2PBR2)
- 2-wire sensors wire directly in series with an ac load, exactly like a limit switch
- Low, 1-milliamp off-state leakage current assures direct interface compatibility with programmable logic controllers (PLCs) and other electronic devices
- Power blocks slide easily into the wiring area of any sensor block and interconnect, without wiring, when the logic module is installed
- Wiring connections are made to heavy-duty screw terminals which accept up to #14 gauge wire - no wire lugs are necessary
- 2-wire power block models 2PBR and 2PBR2 are designed for use with 2-wire sensor blocks and logic modules and offer electromechanical relay output contacts for switching loads up to 5 amps
- All 2-wire ac power blocks are color-coded black

MULTI-BEAM 2-Wire AC Power Blocks

Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
2PBA	105-130V ac	SPST 2-wire Solid-state	130V ac max 750 mA max	<10V ac	<1.0 mA	
2PBB	210-250V ac	SPST 2-wire Solid-state	250V ac max 750 mA max	<10V ac	<1.0 mA	
2PBD[3]	22-28V ac	SPST 2-wire Solid-state	28V ac max 750 mA max	<10V ac	<1.0 mA	

MULTI-BEAM 2-Wire AC Power Blocks

Models	Supply Voltage	Output Type	Output Capacity	On-State V Saturation	Off-State Leakage	Hookup Diagram
2PBR[1, 3]	105-130V ac	SPST Isolated Electro-mechanical relay	250V ac max or 30V dc max 5A max	0V	0 mA	
2PBR2[2, 3]	105-130V ac	SPDT Electro-mechanical relay	250V ac max or 30V dc max 5A max	0V	0 mA	

[1]NOTE: Model 2PBR is a 4-wire power block which works with 2-wire sensor blocks and logic modules and offers an SPST "hard" contact for switching heavy ac or dc loads.
[2]NOTE: Model 2PBR2, also for use with 2-wire sensor blocks and logic modules, uses a 3- or 4-wire hookup with SPDT "hard" contacts for switching heavy ac loads
[3]NOTE: Models 2PBD, 2PBR, and 2PBR2 do not carry UL or CSA approval

MULTI-BEAM 2-Wire AC Power Block Specifications

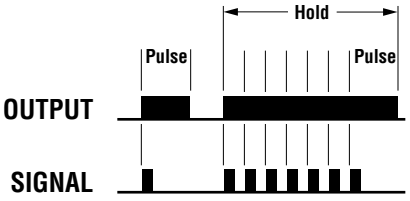
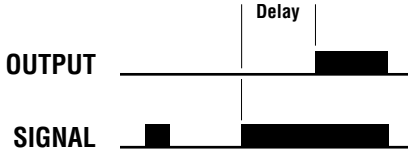
Supply Voltage and Current	See individual model specifications
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	See individual model specifications
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	Add 8.3 milliseconds to the off-time response of the sensor block Add 20 milliseconds to the on and off response time of the sensor block for models 2PBR & 2PBR2
Environmental Rating	Meets NEMA standards 1, 3, 12, and 13; IEC IP66 when assembled with sensor head
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Additional Specifications	For 2PBR and 2PBR2 Models: **Contact rating:** 250V ac max, 30V dc max, 5 amps max (resistive load); install MOV across contact if switching an ac inductive load **Closure time:** 20 milliseconds **Release time:** 20 milliseconds **Maximum switching speed:** 20 operations/second **Mechanical life of relay:** 10,000,000 operations
Certifications	CE, CSA® [3], UL LISTED [3]

MULTI-BEAM 2-Wire Logic Modules

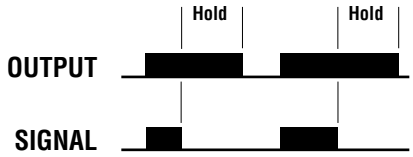
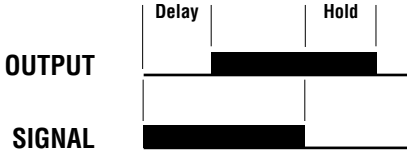
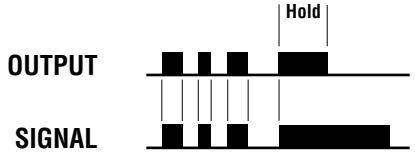
2-wire logic modules are color-coded black

- The logic module interconnects the power block and sensor block, both electrically and mechanically
- Logic modules simply slide into the sensor block, after the power block is installed, to interconnect the three components, without interwiring, using a blade-and-socket connector concept
- Logic modules provide light/dark operate selection and six models offer a selection of adjustable output timing functions
- Totally-encapsulated electronics and gold-plated connectors assure high reliability even in challenging sensing environments
- All 2-wire logic modules are color-coded black

MULTI-BEAM 2-Wire Logic Modules

Models	Timing Function	Timing Range	Timing Diagram
2LM3	On/Off	None	
2LM4-2	One-shot Retriggerable	0.1 to 1 second	
2LM5	On-delay	1.5 to 15 seconds	

MULTI-BEAM 2-Wire Logic Modules

Models	Timing Function	Timing Range	Timing Diagram
2LM5R	Off-delay	1.5 to 15 seconds	
2LM5-14	On-delay and Off-delay	1.5 to 15 seconds (both delays)	
2LM5T	Limit timer (time limited On/Off)	1.5 to 15 seconds	

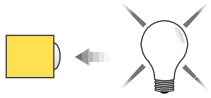
MULTI-BEAM 2-Wire Logic Modules Specifications

Response Time	Response time will be that for the sensor block (plus power block) plus the programmed delay (if the logic includes a delay function)
Timing Repeatability	±2% of maximum range under constant power supply and temperature conditions; ±5% of maximum range under all conditions of supply voltage and temperature
Timing Range	Useful range is from maximum time down to 10% of maximum (e.g. - from 1 to 0.1 seconds, or from 15 to 1.5 seconds). When timing potentiometer is set fully counterclockwise, time will be approximately 1% of maximum.
Adjustments	One or two single turn potentiometers with slot for blade-type screwdriver adjustment NOTE: when turning time adjustments fully clockwise or counterclockwise, avoid excessive torque to prevent damage to potentiometer.
Construction	Molded thermoplastic polyester housing totally epoxy-encapsulated electronic components, and gold-plated blade connectors
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE

MULTI-BEAM Ambient Light Receivers

MULTI-BEAM Ambient Light Receiver , model SBARIGHF (shown) is equipped with an upper cover assembly (model UC-RF) which allows an individual glass fiber optic assembly to be attached to the receiver optoelement

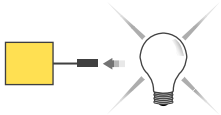
- Non-modulated receiver sensor blocks are operated by sun, incandescent, infrared or laser light sources
- Use to sense daylight for outdoor lighting control; use to sense the heat (infrared light) energy emitted by hot or molten glass, metal or plastic during processing of these materials
- Range depends upon both the intensity of the light source and the contrast between the light source and all other ambient light
- High gain model SBAR1GH is about 20 times as sensitive to light as compared to model SBAR1
- Model SBAR1GHF allows an individual glass fiber optic cable to “pipe” light from a sensing location that is too confined or too hot for the sensor block
- Accepts either 2-wire or 3- and 4-wire power blocks and logic modules

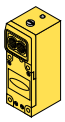


MULTI-BEAM Ambient Light Receiver

Models	Response	Amplifier	Optical Response	Notes
SBAR1	10 ms on/off	Normal Gain	Ultraviolet through near infrared (includes all visible wavelengths)	MULTI-BEAM ambient light receivers do not have the AID™ signal strength. The alignment indicator is “ON” steadily when enough light is sensed.
SBAR1GH		High Gain*		

*20x more sensitive to light as compared to the SBAR1



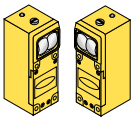


MULTI-BEAM Glass Fiber Optic Ambient Light Receiver

Models	Response	Amplifier	Optical Response	Notes
SBAR1GHF	10 ms on/off	High Gain	Wavelengths from visible blue through near infrared	• Model SBAR1GHF is identical to model SBAR1GH except that it is equipped with an upper cover assembly which allows an individual glass fiber optic assembly to be attached to the receiver optoelement. • This model is used for ambient light detection in locations which are either too confined or too hot for mounting of the complete sensor block.

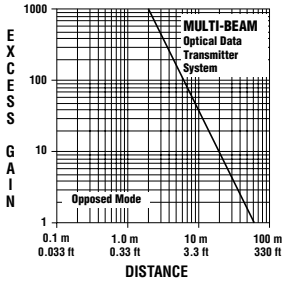
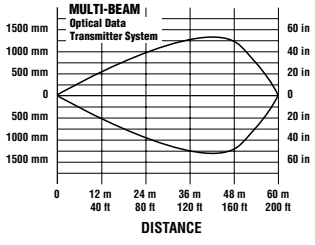
MULTI-BEAM Optical Data Transmitter System

- Provides a very simple and economical means of transmitting logic-level data over a modulated LED light beam
- Ideal for communication with overhead cranes and other rail-mounted systems; replaces brush contacts in rotary index table applications
- Emitter uses a modulated light sources that is gated on and off by the data signal; the receiver output “follows” the action of the data steam
- Data may be transmitted over a distance of up to 60 m (200') at a data transfer rate of up to 300 BAUD



Infrared, 940 nm

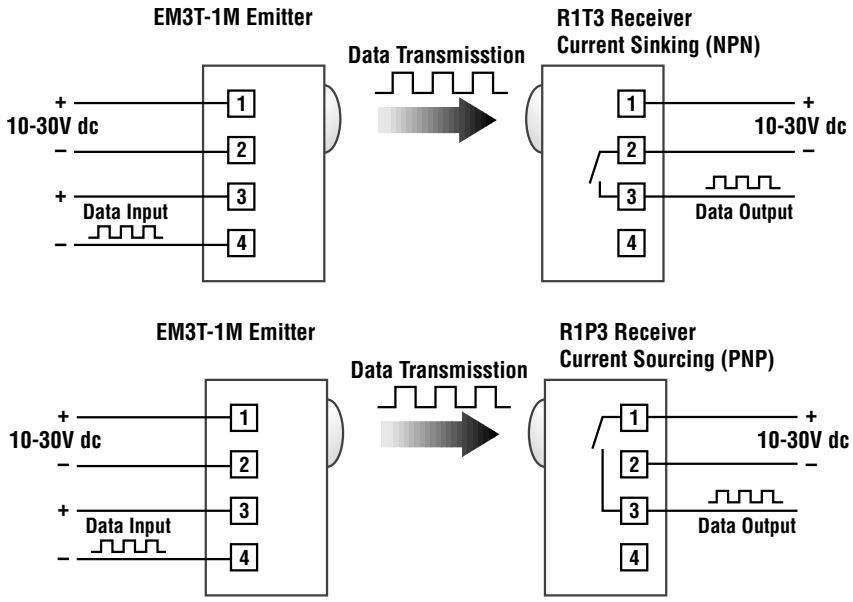
MULTI-BEAM Optical Data Transmitter Emitter (E) and Receiver (R)

Models	Range	Supply Voltage	Output Type	Excess Gain	Beam Pattern
EM3T-1M	60 m (200')	10 to 30V dc	None - emitter only		
R1T3			NPN		
R1P3			PNP		

MULTI-BEAM Optical Data Transmitter Specifications

Supply Voltage and Current	10 to 30V dc (10% maximum ripple) **EM3T-1M** 100 mA max; **R1T3** and **R1P3** 30 mA max, exclusive of load
Supply Protection Circuitry	Protected against transient voltages
Input Signal	The input consists of the LED portion of an optical coupler NOTE: a suitable series resistor (customer supplied) must be installed to limit current to between 10 and 30 mA dc. When current is applied to the LED, the 30 kHz carrier is inhibited.
Output Configuration	R1P3: Open-collector current sourcing (PNP) R1T3: open-collector current sinking (NPN)
Output Rating	250 mA maximum **Off-state leakage current** less than 10 microamps **On-state voltage** less than 1V dc
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	1 millisecond ON and OFF. Maximum data rate: 300 BAUD
Indicators	Red LED on top of receiver. Banner's exclusive, patented Alignment Indicating Device system (AID™) lights the LED indicator whenever the sensor detects the light from the EM3T-1M, and pulses the LED at a rate proportional to the received light level. It will go "off" with current applied to the emitter input.
Construction	Reinforced thermoplastic polyester, totally encapsulated housing and stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 3, 12, and 13; IEC IP54
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	i) The data transmitter consists of a special MULTI-BEAM emitter sensor block (model SBEM3) and dc power block (model PBT-1M) ii) The data receiver (model R1T3) is composed of standard MULTI-BEAM components: sensor block SBR1, power block PBT, and on/off logic model LM3
Certifications	CE

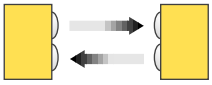
MULTI-BEAM Optical Data Transmitter Hookup Diagrams



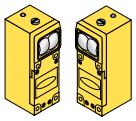
MULTI-BEAM Optical Edgeguide System

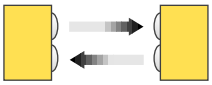
- Used in pairs (two required per system) to provide complete edgeguiding sensing and control of opaque materials
- Pairs are used in the opposed mode to provide two beams which control edge limits (inward and outward)
- Deadband between control limits is easily adjusted by positioning of the sensors relative to the material edge being guided
- Adjustable time delays provide required overtravel hysteresis
- Direct interface to ac loads up to 3/4 amp; models for 120 or 240V ac
- Rugged MULTI-BEAM construction, plus very high excess gain at close ranges, permits reliable control in harsh environments such as sawmills or power sanding machines

MULTI-BEAM Edgeguide Sensing Mode Options

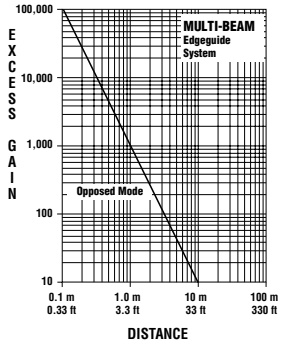


Opposed





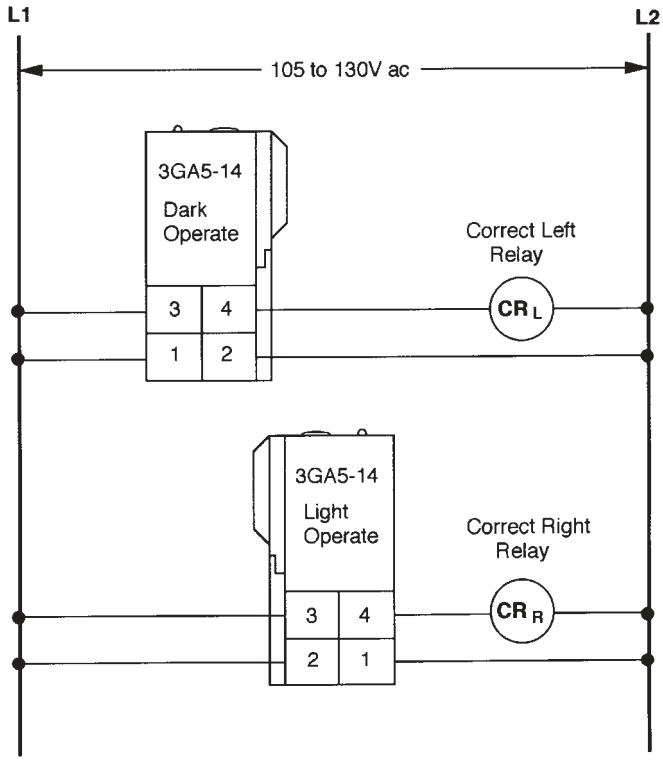
MULTI-BEAM Optical Edgeguide Emitter (E) and Receiver (R)

Models	Range	Supply Voltage	Output Type	Excess Gain
3GA5-14 (order two)	30 m (100')	105-130V ac	Two SPST Solid-state	
3GB5-14 (order two)		210 - 250V ac		

MULTI-BEAM Optical Edgeguide Specifications

Supply Voltage and Current	3GA5-14: 105 to 130V ac (50/60 Hz) 3GB5-14: 210 to 250V ac (50/60 Hz)
Supply Protection Circuitry	Protected against transient voltages
Output Configuration	Solid-state switch, ¾ amp maximum, derated to ½ amp at 70°C
Output Rating	**Inrush capability** is 10 amps max for 1 second or 30 amps for one ac cycle (non-repeating) **Off-state leakage current** less than 100 microamps **On-state voltage** less than 2.5V dc at full load
Output Protection Circuitry	Protected against false pulse on power-up
Output Response Time	Response time is a function of the ON and OFF delay timers, which are independently adjustable over a useful range of from 1 to 15 seconds NOTE: shorter time ranges are available on a quote basis
Indicators	Red LED status indicator on top of the housing is “on” when the receiver detects modulated light (unblocked) condition
Construction	Reinforced thermoplastic polyester, totally encapsulated housing and stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 3, 12, and 13; IEC IP54
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	The Edgeguide system is composed of two each of: sensor block 3SBG, power block 3PBA (120V ac) or 3PBB (240V ac), and on/off logic model 3LM5-14
Certifications	CE

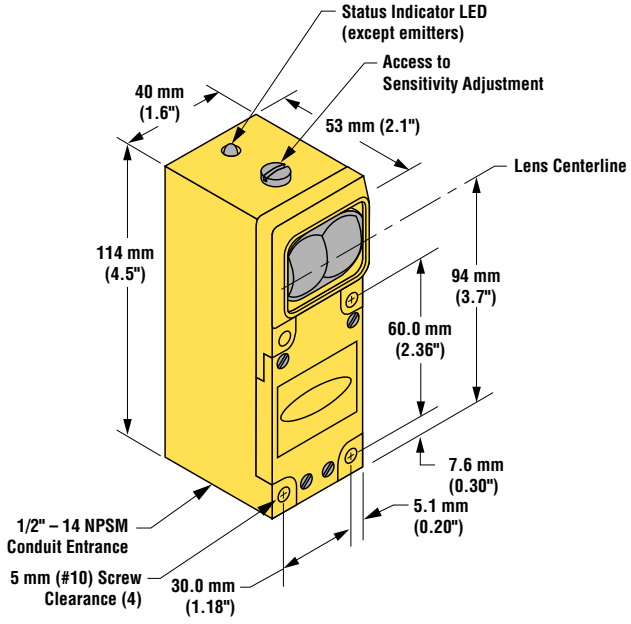
MULTI-BEAM Optical Edgeguide Hookup Diagram



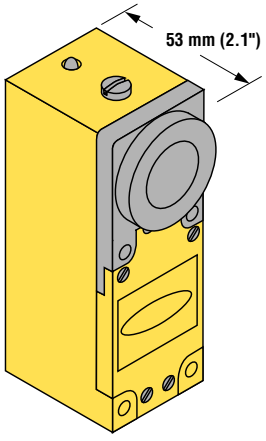
NOTE: Be certain to connect L_1 and L_2 exactly as shown to terminals 1 and 2

MULTI-BEAM Dimensions

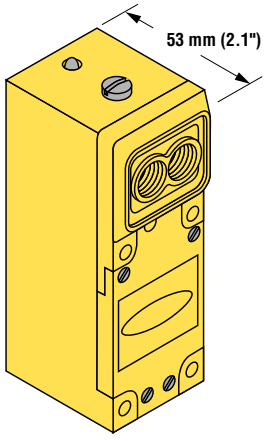
Assembled MULTI-BEAM Sensor w/standard Lens
Opposed, Retroreflective, Diffuse, Ambient Light Receiver, Optical Data Transmitter and Edgeguide
Model suffix E, ED, EV, EX ,EXD, R, RD, RX, RXD, L, LV, LVAG, LX, D, DL, DX, & AR and model prefix 3GA & EM3T



Assembled MULTI-BEAM Sensor w/convergent lens
Model suffix C, CV and CX



Assembled MULTI-BEAM Sensor w/glass fiber cover
Model suffix AR1GHF, F, FX, FV, FVG, EF, RF, EXF and RXF



Modifications

Model Suffix	Modification	Description	Example of Model Number
MHS	Modified for High Speed	Sensor blocks with 1 millisecond response may be modified for (300 µs) response. NOTE: Faster response comes at the expense of lower excess gain and decreased sensor immunity to some forms of electrical "noise".	SBF1MHS
MZ	Zero Hysteresis	Amplifier hysteresis may be removed from 3- and 4-wire sensor blocks when attempting to sense small signal changes (contrasts less than 3).	SBLV1MZ

Quick-Disconnect (QD) Cables and Connectors

Connector MBC-4 adapts any MULTI-BEAM sensor assembly to accept 4-wire mini-style quick-disconnect cables.

Style	Model	Length	Connector	
4-Pin Mini	**Connector to install in base of sensor block** **MBC-4**	Wire Length: 300 mm (12")	Straight	
	Mating Cables **MBCC-406** **MBCC-412** **MBCC-430**	Cable Length: 2 m (6.5') 4 m (12') 9 m (30')		

Cable Gland Assembly

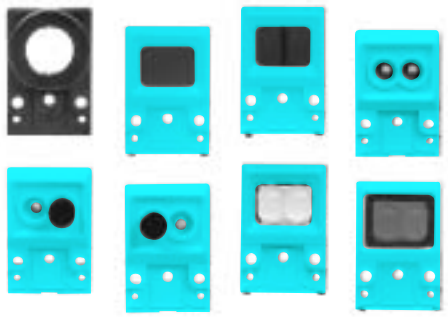
Model	Description	
RF1-2NPS	• Cable gland assembly for MULTI-BEAMs • Includes cord grips for 2.5 to 10 mm (0.1 - 0.4 in) diameter cable • Bracket lockwasher is also included	

Cable Protector

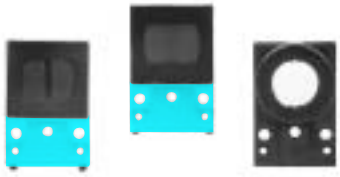
Model	Description	
HF1-2NPS	• Flexible black nylon cable protector • Includes a neoprene gland that compresses around the MULTI-BEAM cable to provide an additional seal against moisture • Resistant to gasoline, alcohol, oil, grease, solvents and weak acids • Working temperature range of -30° to +100°C (-22° to +212°F)	

Replacement Lens Assemblies

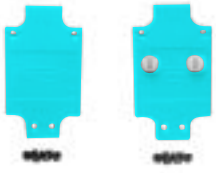
Model	Description	
Upper Covers		
An upper consists of the optical element for the MULTI-BEAM which is built into a gasketed cover for the upper portion of the sensor block. Upper covers may be ordered as replacement parts or for modifying the optical response of a particular model sensor block.		
UC-C	38 mm (1.5") focus	SBC1, SBCV1, SBCVG1, SBCX1 & 2SBC1
UC-C4	100 mm (4") focus	SBC1-4 & SBCX1-4
UC-C6	150 mm (6") focus	SBC1-6 & SBCX1-6
UC-D	Flat vinyl for short range and/or wide beam angle	Replacement lens for SBD1, SBED, SBRD1, SBEXD, SBRXD1 & 2SBD1
UC-DMB	"MB" = Modified with Baffle; for short-range proximity mode with SBDX1	Replacement lens for SBDX1MD
UC-F	Fits all Banner glass fiber optic assemblies	Replacement lens for SBF1, SBFX1, SBFV1 & 2SBF1
UC-EF	For fiber optic emitter-only sensor blocks	Replacement lens for SBEF & SBEXF
UC-RF	For fiber optic receiver-only sensor blocks	Replacement lens for SBRF1, SBRXF1 & SBAR1GHF
UC-L	Standard bifurcated acrylic lens	Replacement lens for SBE, SBEV, SBEX, SBR1, SBRX1, SBL1, SBLV1, SBLX1, SBDL1, SBDX1, SBAR1, SBAR1GH, 2SBR1, 2SBL1, 2SBDX1, 3GA5-14, EM3T-1M & R1T3
UC-LAG	Anti-glare (polarizing for retroreflective sensing of shiny objects)	Replacement lens for SBLVAG1



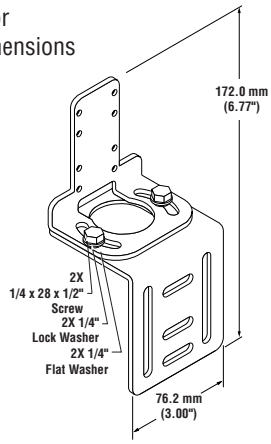
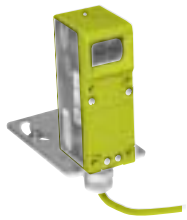
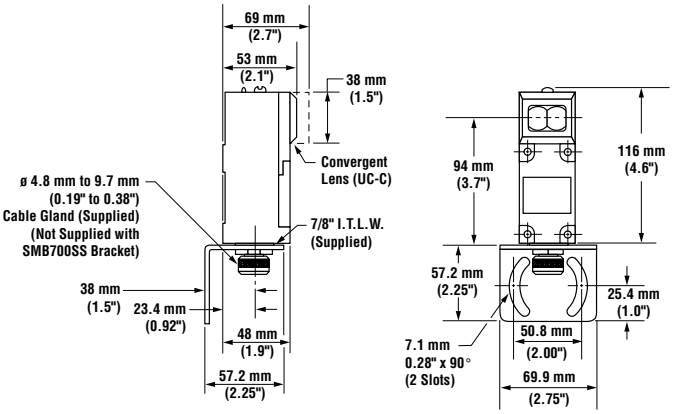
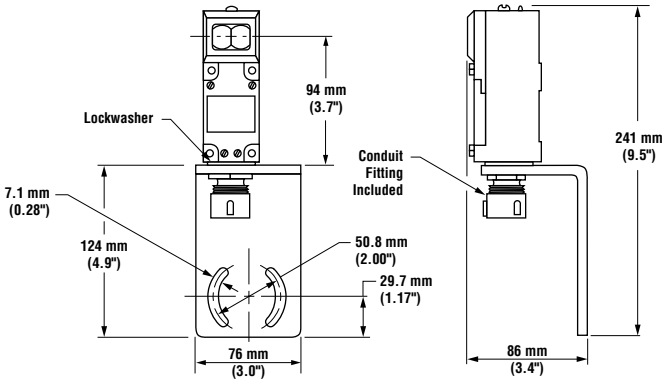
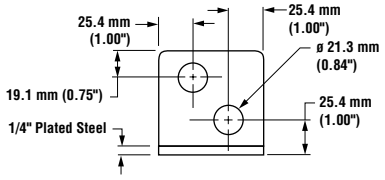
Special Upper Covers	
These upper covers are used in special sensing environments.	
UC-DJ	Identical to UC-D, but with addition of plastic dust cover to prevent accumulation of dust/dirt in lens area
UC-LJ	Adds plastic dust cover to UC-L. Used when sensor is mounted facing up (used to prevent dust/dirt buildup on lens)
UC-LG	Replaces UC-L in sensing locations where highly caustic materials are present (e.g. acid vapor or splash). Glass lens.



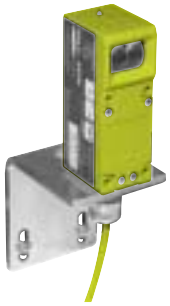
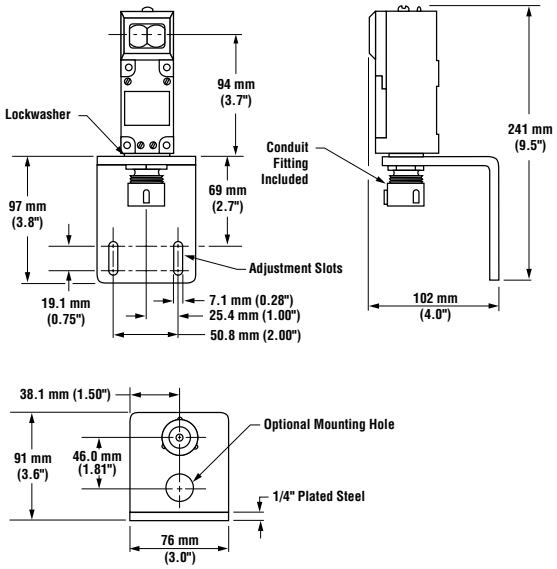
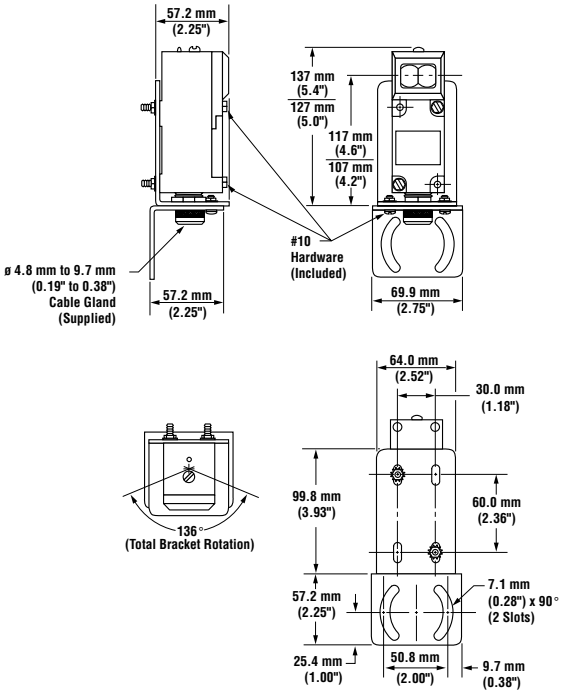
Lower Covers	
Replacement lower covers fit all MULTI-BEAM sensor blocks. Lower covers include gaskets and four stainless steel mounting screws.	
LCMB	Standard replacement cover for all sensor blocks
LCMBMTA	"MTA" = Modified Timing Access. Gasketed nylon screw covers for logic module timing adjustments.



Mounting Brackets

Model	Description	Dimensions
SMB30UR 	• 2-piece universal swivel bracket for limit-switch style sensors • 300 series stainless steel • Includes stainless steel swivel locking hardware	NOTE: See p. 746 for additional dimensions 
SMB700 **SMB700F** **SMB700SS** 	SMB700: • Right angle, 11-gauge, zinc plated steel, 2-axis mounting bracket supplied with cable gland assembly and lockwasher SMB700F; • Flat, single-axis version of SMB700, sold without hardware SMB700SS: • 11-gauge , stainless steel version of SMB700 sold without hardware	
SMB700M 	• Heavy-duty 6 mm (0.25") zinc plated steel bracket • Allows MULTI-BEAM to retrofit to installations of MICRO-SWITCH models MLS8 or MLS9 sensors • Includes cable gland and lockwasher	 

Mounting Brackets

Model	Description	Dimensions
SMB700P 	• Heavy-duty 6 mm (0.25") zinc plated steel bracket • Allows MULTI-BEAM to retrofit to installations of PHOTOSWITCH series 42RLU or 42RLP sensors • Includes cable gland and lockwasher	
SMBLS 	• Two 11-gauge zinc plated steel, right angle brackets which fasten together so that they can rotate relative to each other • Assembly hardware and cable gland are included	

Parts Sensing Light Screens

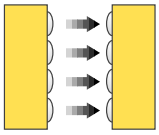
Parts Sensing Light Screens are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

Parts Verification Array (PVA)

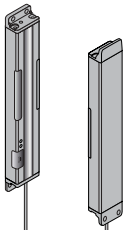
Light Screen for Error Proofing Bin-Picking Operations

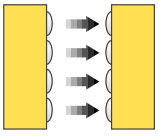
- Compact package size; only 30 mm wide x 15 mm deep (1.2" x .6"). Available in 4 lengths: 100 mm, 225 mm, 300 mm, 375 mm (4", 9", 12", 15") to fit many sizes and/or configurations of parts bins.
- Two-component system (asynchronous emitter and receiver) needs no synch wire or controller box.
- Two LEDs on each emitter and receiver indicates proper setup and system errors.
- Both emitter and receiver have clearly visible green job indicator lights mounted on either side of the housing; the light can be remotely controlled to initiate user action with a solid or a blinking light.
- 2-frequency setting prevents optical crosstalk for multiple-array, close-proximity installations
- Easy DIP-switch adjustments for light/dark operate, solid/flashing job light indicator, A/B frequency, and gate polarity for activating the job light indicator
- Choose 2 m (6.5') unterminated cable or 2m (6.5') cable with 4-pin Euro-style quick-disconnect connector.
- Minimum resolution 35 mm (1.4") for all models.
- Wide beam pattern provides easy alignment.
- Emitters and receivers sold separately or in pairs for easy ordering.
- Heavy-duty protective bracket available

PVA Sensing Mode Options



Opposed

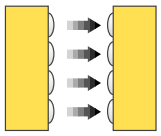




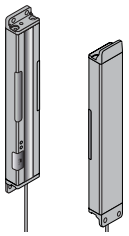
Infrared, 880 nm

Parts Verification Array Models

Models	Description	Array	Cable*	Supply Voltage	Job Light Input	Receiver Output	Minimum Resolution
PVA100N6 **PVA100N6E** **PVA100N6R**	Emitter/Receiver Pair Emitter Receiver	100 mm (4") Long, 5 Beams	2 m (6.5') Unterminated	12 to 30 V dc	0V dc	NPN (Sinking)	35 mm
PVA100P6 **PVA100P6E** **PVA100P6R**	Emitter/Receiver Pair Emitter Receiver				+5 to 30V dc	PNP (Sourcing)	
PVA100N6Q **PVA100N6EQ** **PVA100N6RQ**	Emitter/Receiver Pair Emitter Receiver		2 m (6.5') Euro-style Quick-disconnect		0V dc	NPN (Sinking)	
PVA100P6Q **PVA100P6EQ** **PVA100P6RQ**	Emitter/Receiver Pair Emitter Receiver				+5 to 30V dc	PNP (Sourcing)	



Infrared, 880 nm



Parts Verification Array Models

Models	Description	Array	Cable*	Supply Voltage	Job Light Input	Receiver Output	Minimum Resolution
PVA225N6 **PVA225N6E** **PVA225N6R**	Emitter/Receiver Pair Emitter Receiver	225 mm (9") Long, 10 Beams	2 m (6.5') Unterminated	12 to 30 V dc	0V dc	NPN (Sinking)	35 mm
PVA225P6 **PVA225P6E** **PVA225P6R**	Emitter/Receiver Pair Emitter Receiver				+5 to 30V dc	PNP (Sourcing)	
PVA225N6Q **PVA225N6EQ** **PVA225N6RQ**	Emitter/Receiver Pair Emitter Receiver		2 m (6.5') Euro-style Quick-disconnect		0V dc	NPN (Sinking)	
PVA225P6Q **PVA225P6EQ** **PVA225P6RQ**	Emitter/Receiver Pair Emitter Receiver				+5 to 30V dc	PNP (Sourcing)	
PVA300N6 **PVA300N6E** **PVA300N6R**	Emitter/Receiver Pair Emitter Receiver	300 mm (12") Long, 13 Beams	2 m (6.5') Unterminated	12 to 30 V dc	0V dc	NPN (Sinking)	35 mm
PVA300P6 **PVA300P6E** **PVA300P6R**	Emitter/Receiver Pair Emitter Receiver				+5 to 30V dc	PNP (Sourcing)	
PVA300N6Q **PVA300N6EQ** **PVA300N6RQ**	Emitter/Receiver Pair Emitter Receiver		2 m (6.5') Euro-style Quick-disconnect		0V dc	NPN (Sinking)	
PVA300P6Q **PVA300P6EQ** **PVA300P6RQ**	Emitter/Receiver Pair Emitter Receiver				+5 to 30V dc	PNP (Sourcing)	
PVA375N6 **PVA375N6E** **PVA375N6R**	Emitter/Receiver Pair Emitter Receiver	375 mm (15") Long, 16 Beams	2 m (6.5') Unterminated	12 to 30 V dc	0V dc	NPN (Sinking)	35 mm
PVA375P6 **PVA375P6E** **PVA375P6R**	Emitter/Receiver Pair Emitter Receiver				+5 to 30V dc	PNP (Sourcing)	
PVA375N6Q **PVA375N6EQ** **PVA375N6RQ**	Emitter/Receiver Pair Emitter Receiver		2 m (6.5') Euro-style Quick-disconnect		0V dc	NPN (Sinking)	
PVA375P6Q **PVA375P6EQ** **PVA375P6RQ**	Emitter/Receiver Pair Emitter Receiver				+5 to 30V dc	PNP (Sourcing)	

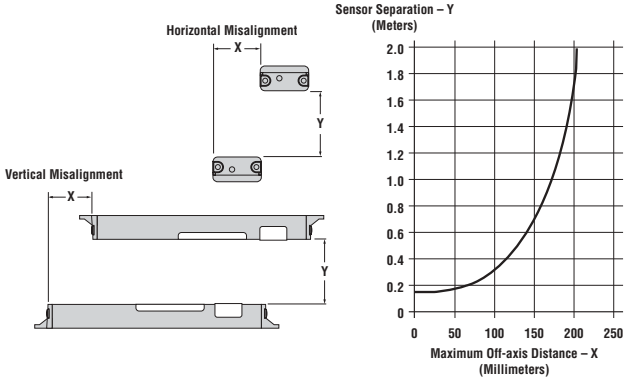
* NOTE: Cable diameter is 3.3 mm (0.13") on all models.

WARNING . . . Not To Be Used for Personnel Protection

Never use this product as a sensing device for personnel protection. Doing so could lead to serious injury or death.

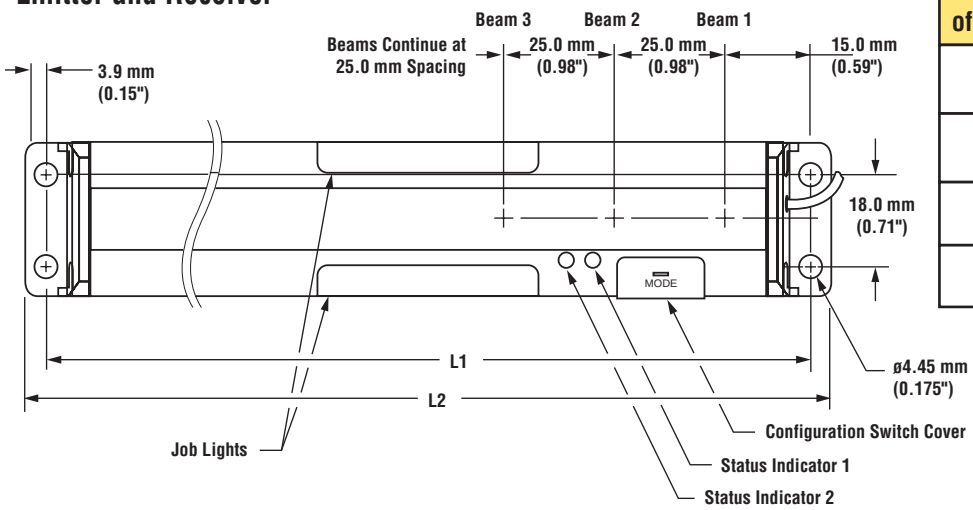
This product does NOT include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition. Consult your current Banner Safety Products catalog for safety products which meet OSHA, ANSI and IEC standards for personnel protection.

Parts Verification Array Specifications

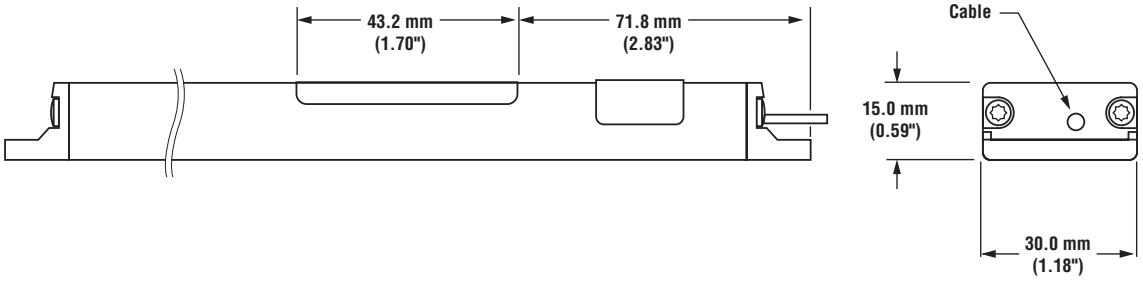
Supply Voltage and Current	12 to 30V dc (10% maximum ripple) at less than 62 mA for the emitter and 50 mA for the receiver (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity
Sensing Range	2 m (6.5 ') with 2x excess gain remaining
Sensing Height	100 mm (3.9"), 225 mm (8.9"), 300 mm (11.8"), or 375 mm (14.8"), depending on emitter and receiver models
Beam Spacing	25.0 mm (0.98")
Sensing Resolution	35 mm (1.4") minimum diameter
Output Configuration	Receivers have one solid-state dc output, programmable for light or dark operate: Models PVA...N6R have current sinking (NPN) open-collector transistor Models PVA...P6R have current sourcing (PNP) open-collector transistor
Output Rating	150 mA maximum **Off-state leakage** current less than 2 microamps **On-state saturation** voltage less than 1V dc at 10 mA and less than 1.5V dc at 100 mA
Output Protection Circuitry	Protected against false pulse at power-up and continuous overload or short circuit of outputs
Output Response Time	Sensor Size / Standard / With Crosstalk from Adjacent Units 100 mm / 20 ms / 30 ms 225 mm / 40 ms / 60 ms 300 mm / 52 ms / 78 ms 375 mm / 64 ms / 96 ms
Status Indicators	**Emitter:** One green LED to indicate power ON/OFF One red LED to indicate frequency selected **Receiver:** One green LED to indicate power ON/OFF One yellow LED to indicate output state **Emitter & Receiver:** Both have two highly visible "job lights" which are turned ON and OFF by applying an external signal to the white wire. The job lights may be programmed for steady or flashing green.
Construction	Black painted aluminum housing; acrylic lenses; thermoplastic polyester end caps; thermoplastic elastomer programming switch cover; stainless steel mounting brackets and hardware
Environmental Rating	NEMA 2; IEC IP62
Connections	**Emitter:** 3-conductor PVC-jacketed 2 m (6.5') cable which is either unterminated or terminated with a 4-pin Euro-style quick-disconnect connector, depending on model (see model selection chart, pages 520 and 521). Cable diameter is 3.3 mm (0.13"). **Receiver:** 4-conductor PVC-jacketed 2 m (6.5') cable which is either unterminated or terminated with a 4-pin Euro-style quick-disconnect connector, depending on model (see model selection chart, pages 520 and 521). Cable diameter is 3.3 mm (0.13").
Operating Temperature	0° to +50°C (+32° to 122°F)
Maximum Off-axis Misalignment	

Parts Verification Array Dimensions

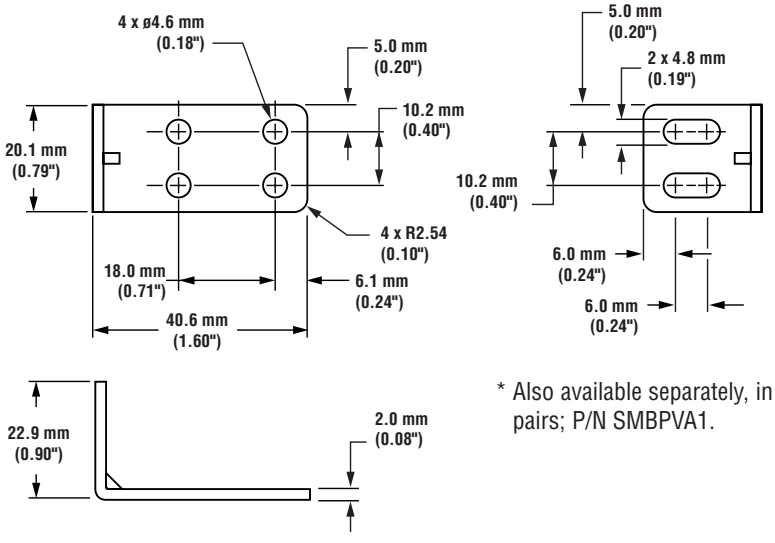
Emitter and Receiver



Number of beams	L1	L2
5	130.0 mm (5.12")	137.8 mm (5.43")
10	258.5 mm (10.18")	266.4 mm (10.49")
13	333.5 mm (13.13")	341.4 mm (13.44")
16	408.5 mm (16.09")	416.6 mm (16.40")



Bracket – 2 supplied with each sensor*

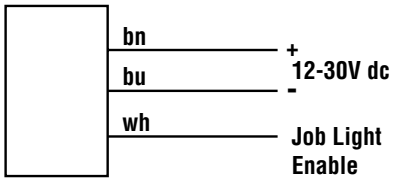


* Also available separately, in pairs; P/N SMBPVA1.

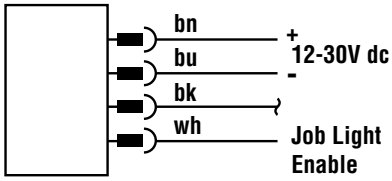
Hardware (included with each sensor)	
P/N	**Includes**
50532	4 Stainless steel Phillips panhead machine screws (M4 x 0.7 x 12)
	4 Stainless steel hex nuts (M4 x 0.7)
	4 Stainless steel lock washers (M4 x 0.7)
	1 Plastic screwdriver (3.6 cm/1.4" long)

Parts Verification Array Hookup Diagrams

Emitter with Unterminated Cable

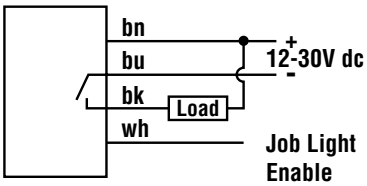


Emitter with Quick-Disconnect (4-Pin Euro-Style)

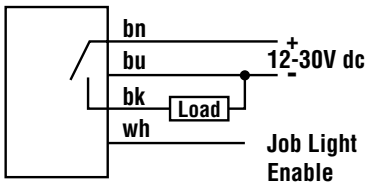


Receiver with NPN (Sinking) Output

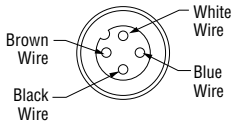
NOTE: Receiver hookups are functionally the same for either cabled or quick-disconnect models.



Receiver with PNP (Sourcing) Output



4-Pin Euro-Style Pin-out



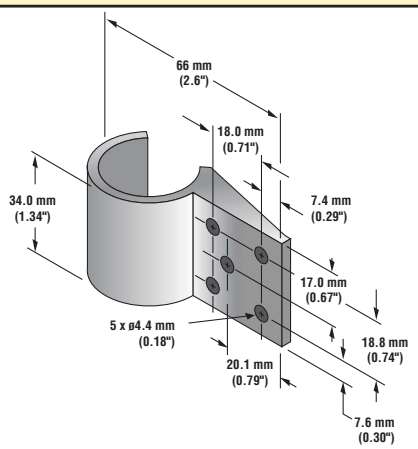
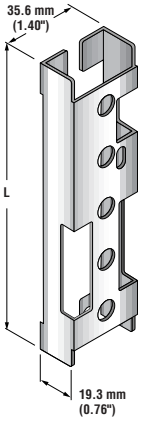
Quick-Disconnect (QD) Option

All models feature integral 2 m (6.5') long, 3.3 mm (0.13 in) diameter. PVC-jacketed cables. Models whose model numbers end in “Q” are terminated with quick-disconnect (QD) Euro-style 4-pin connectors; other models have unterminated ends. For information on optional mating QD cables, see page 525.

Quick-Disconnect (QD) Cables

Style	Model	Length	Connector	For use with
4-Pin Euro	**MQDC-406**	2 m (6.5')	Straight	PVA light screens
	MQDC-415	5 m (15')	Straight	
	MQDC-430	9 m (30')	Straight	
	MQDC-406RA	2 m (6.5')	Right-Angle	
	MQDC-415RA	5 m (15')	Right-Angle	
	MQDC-430RA	9 m (30')	Right-Angle	

Mounting Brackets

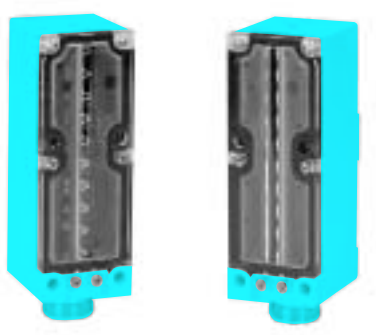
Model	Description	Dimensions
SMBPVA2 	• Set of 4 molded brackets • Snaps onto standard 28 mm diameter pipe	
SMBPVA5 **SMBPVA10** **SMBPVA13** **SMBPVA16** 	• Protects sensors against impact • Set of 2 • Heavy-duty cold-rolled steel, zinc finish	

Model	Used With	"L"
SMBPVA5	PVA100	139.7 mm
SMBPVA10	PVA225	268.2 mm
SMBPVA13	PVA300	343.3 mm
SMBPVA16	PVA375	418.2 mm

NOTE: Basic mounting brackets are included with PVA System. See page 523.

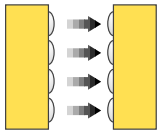
LS PART SENSING LIGHT SCREENS

For Sensing Small Objects Moving at High Speeds



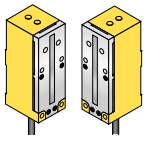
LS10 emitter and receiver shown

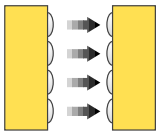
LS Series Sensing Mode Options



Opposed

- Emitter and receiver pair produce a strobed array of modulated light beams to produce a light screen
- Simple, economical and highly reliable means of sensing small parts which pass anywhere through the light screen
- Light screen area measures 90 mm (3.5") by the distance of separation between the emitter and receiver
- Fast, 1 millisecond response; output includes a 5-millisecond pulse stretcher for interfacing reliability
- LS10 models have tight beam spacing for sensing small parts (as small as 5.6 mm in diameter)
- Lower cost LS4 models have longer sensing range
- Totally self-contained; very rugged with totally encapsulated circuitry
- Bipolar design offers the choice of NPN (current sinking) or PNP (current sourcing) outputs from the same receiver; both outputs may be used simultaneously
- LS4 models offer choice of integral cable or quick-disconnect fitting; LS10 models are quick-disconnect only. Contact factory for information on availability of models with alternate cables and quick-disconnect fittings





Infrared, 880 nm

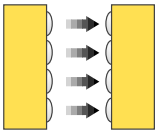
LS10 Series Opposed Mode Emitter (E) and Receiver (R)

Models	Range	Cable	Supply Voltage	Output Type	Minimum Resolution
LS10ESR	100 - 200 mm (4 - 8")	3-Pin Mini QD	12-30V DC	Bipolar NPN/PNP DO	5.6 mm (0.22")
LS10RSR		4-Pin Mini QD			
LS10E	100 - 1220 mm (4 - 48")	3-Pin Mini QD			7.6 mm (0.30")
LS10R		4-Pin Mini QD			

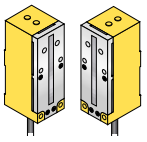
For LS10 Series Part Sensing Light Screens:

i) LS10 Series models come standard with either a 3- or 4-pin mini-style quick-disconnect connector.

iii) A model with a QD connector requires an accessory mating cable. See page 530 and the Accessories section for more information.



Infrared, 880 nm

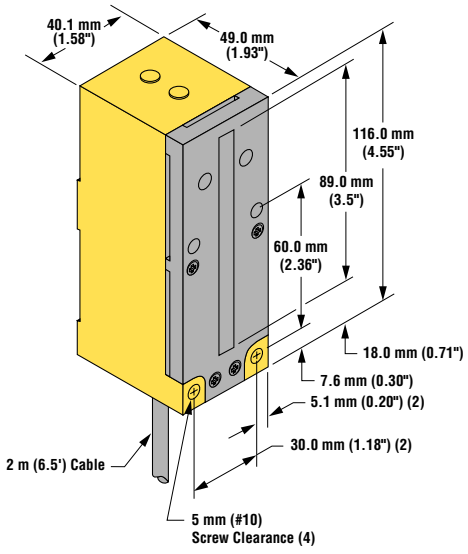


LS4 Series Opposed Mode Emitter (E) and Receiver (R)

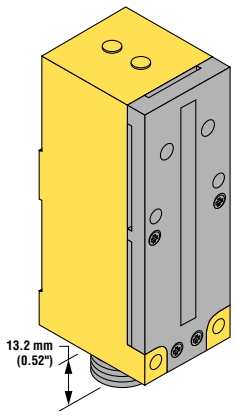
Models	Range	Cable	Supply Voltage	Output Type	Minimum Resolution
LS4EL	0.46 - 2.29 m (18 - 90")	2 m (6.5')	10-30V DC	Bipolar NPN/PNP DO	25 - 38 mm (1.0 - 1.5") Depending upon location of object within light screen
LS4RL					
LS4ELQ		4-Pin Mini QD			
LS4RLQ					

LS Series Dimensions

LS4EL and LS4RL with Attached Cable



LS Series with Quick-Disconnect

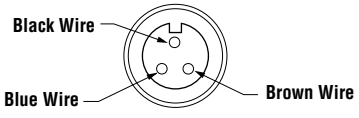


LS Series Specifications

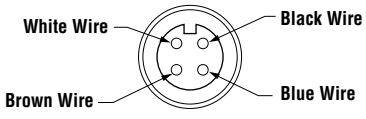
Supply Voltage and Current	**LS10 models:** 12 to 30V dc (10% maximum ripple) at less than 70 mA (emitter) or 45 mA (receiver - exclusive of load) **LS4 models:** 10 to 30V dc (10% maximum ripple) at less than 40 mA (emitter) or 30 mA (receiver - exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity
Output Configuration	Bipolar: One current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	125 mA maximum each output **Off-state leakage current** less than 1 microamp **Output saturation voltage** (PNP output) less than 1 volt at 10 mA and less than 2 volts at 150 mA **Output saturation voltage** (NPN output) less than 200 millivolts at 10 mA and less than 1 volt at 150 mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit of outputs
Output Response Time	Receiver will respond to a “dark” signal of 1 millisecond or longer duration; a 5-millisecond pulse stretcher (off delay) is included to improve interfacing reliability; successive parts must have at least 10 millisecond separation
Repeatability	30 microseconds (light-to-dark)
Resolution	See product selection tables
Indicators	**Power** (emitter only): lights whenever power is applied **Alignment** (receiver only): lights whenever light screen is interrupted
Construction	Reinforced thermoplastic polyester housing, acrylic lenses, and stainless steel hardware
Environmental Rating	Meets NEMA standards 1, 2, 3, 12, and 13; IEC IP54
Connections	See product selection tables
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	i) The best sensing resolution occurs near the center of the sensing area, between the emitter and receiver (i.e. - near the center of the opposed distance) ii) Outputs are energized continuously while the light screen is interrupted iii) A 5-millisecond pulse stretcher (off delay) is included to improve interfacing reliability; successive parts must have at least 10 millisecond separation
Certifications	CE

LS Series Hookup Diagrams

3-Pin Mini-Style Pin-out (Cable Connector Shown)

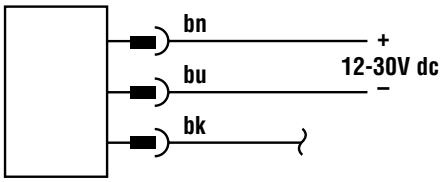


4-Pin Mini-Style Pin-out (Cable Connector Shown)

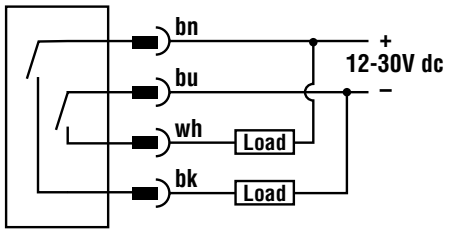


LS Series Hookup Diagrams

LS10 Emitters with Quick-Disconnect (3-Pin Mini-Style)

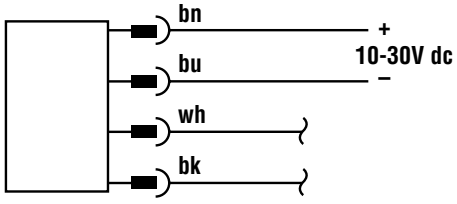


LS10 Receivers with Quick-Disconnect (4-Pin Mini-Style)

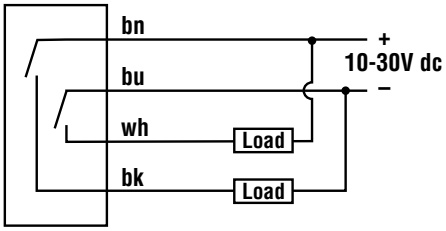


LS4EL Emitter with Attached Cable

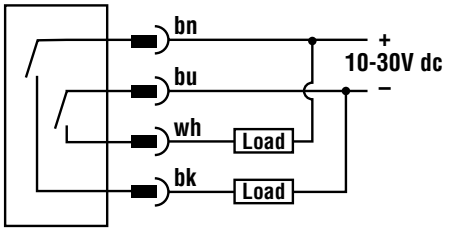
LS4ELQ Emitter with Quick-Disconnect (4-Pin Mini-Style)



LS4RL Receiver with Attached Cable



LS4RLQ Receiver with Quick-Disconnect (4-Pin Mini-Style)



Quick-Disconnect (QD) Option

LS10 Light Screens come standard with either a 3- or 4-pin mini-style QD cable fitting. LS4 Light Screens are sold with either a 2 m (6.5') attached cable or with a 4-pin mini-style QD cable fitting.

LS4 QD Light Screens are identified by the letter “Q” in their model suffix number. Mating cables for LS10 Lights Screens are MBCC-312 and MBCC-412. Mating cable for LS4 Lights Screens is MBCC-412. For more information on QD cables, see page 530 and the Accessories section.

Accessories

Replacement Lens Assemblies

LS Series lens assemblies are field-replaceable.

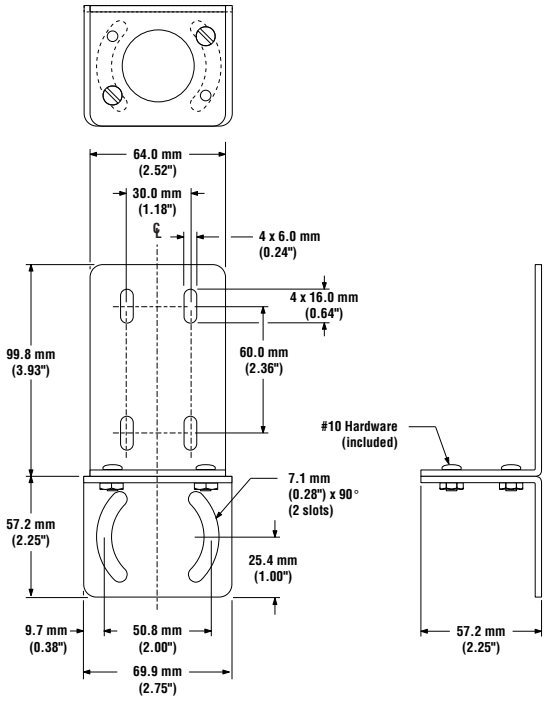
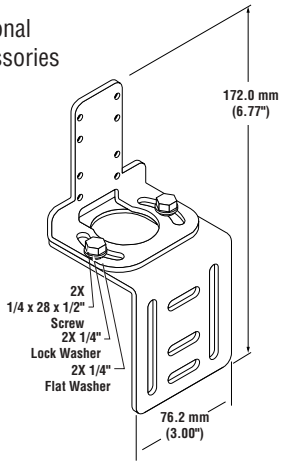
Model	Description
UC-LS10	Replacement lens for LS10E and LS10R
UC-LS10SR	Replacement lens for LS10ESR and LS10RSR
UC-LS4EL	Replacement lens for LS4EL and LS4ELQ
UC-LS4RL	Replacement lens for LS4RL and LS4RLQ

Quick-Disconnect (QD) Cables

Following is the selection of cables available for LS Series QD models. See the Accessories section for more cable information.

Style	Model	Length	Connector	Used with:
3-Pin Mini	**MBCC-306** **MBCC-312** **MBCC-330**	2 m (6.5') 4 m (12') 9 m (30')	Straight	LS10 Series Emitters
4-Pin Mini	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')	Straight	LS10 Series Receivers and models LS4ELQ and LS4RLQ

Mounting Brackets

Model	Description	Dimensions
SMBLS 	• Two 11-gauge zinc plated steel, right angle brackets which fasten together so that they can rotate relative to each other • Assembly hardware and cable gland are included	
SMB30UR 	• 2-piece universal swivel bracket for limit-switch style sensors • 300 series stainless steel • Includes stainless steel swivel locking hardware	For complete dimensional information, see Accessories section, p. 746. 

OPTO-TOUCH™ Switches

IMPORTANT OPTO-TOUCH switches are intended as general-purpose initiators, and are NOT safety devices. They are equally likely to fail in the conducting ("ON") state as in the non-conducting ("OFF") state. They must be used in conjunction with a two-hand control safety relay for machine initiation, wherever false operation of an OPTO-TOUCH switch could be dangerous. NEVER use an OPTO-TOUCH switch as an actuator in an emergency stop (E-stop) circuit.

NOTE: See the Banner Machine Safety Catalog for Series STB self-checking touch buttons and associated DUO-TOUCH SG Two-Hand Control Module.

OPTO-TOUCH

Touch-activated Optoelectronic Switches

OPTO-TOUCH with OTC Series Field Cover

- Select OTB momentary action or LTB alternate action switches
- Output is a 7 amp SPDT electromechanical relay; low-voltage dc OTB models are also available with solid-state outputs
- Choice of polysulfone or Lexan® polycarbonate upper housing (see Specifications for environmental considerations)
- Choose models with integral 2 m (6.5') cable or mini-style quick disconnect connector; 9 m (30') integral cable is also available
- All models are supplied with a black polypropylene (TP) field cover designed to prevent inadvertent switch activation; red, yellow or green field covers are available as options

Momentary Action OTBs

Models	Cable	Upper Housing	Supply Voltage	Output Type
OTBVN6 **OTBVN6QD** **OTBVN6QDH**	2 m (6.5') 4-Pin Mini QD 4-pin Euro QD	Polysulfone	10-30V dc	Complementary NPN
OTBVN6L **OTBVN6LQD** **OTBVN6LQDH**	2 m (6.5') 4-Pin Mini QD 4-pin Euro QD	Lexan®		
OTBVP6 **OTBVP6QD** **OTBVP6QDH**	2 m (6.5') 4-Pin Mini QD 4-pin Euro QD	Polysulfone		Complementary PNP
OTBVP6L **OTBVP6LQD** **OTBVP6LQDH**	2 m (6.5') 4-Pin Mini QD 4-pin Euro QD	Lexan®		
OTBVR81 **OTBVR81QD**	2 m (6.5') 5-Pin Mini QD	Polysulfone	20-30V ac or dc	SPDT Electromechanical Relay
OTBVR81L **OTBVR81LQD**	2 m (6.5') 5-Pin Mini QD	Lexan®		
OTBA5 **OTBA5QD**	2 m (6.5') 5-Pin Mini QD	Polysulfone	120V ac	
OTBA5L **OTBA5LQD**	2 m (6.5') 5-Pin Mini QD	Lexan®		
OTBB5 **OTBB5QD**	2 m (6.5') 5-Pin Mini QD	Polysulfone	220/240V ac	
OTBB5L **OTBB5LQD**	2 m (6.5') 5-Pin Mini QD	Lexan®		

Lexan® is a registered trademark of General Electric Co.

Alternate Action LTBs

Models	Cable	Upper Housing	Supply Voltage	Output Type
LTBA5 **LTBA5QD**	2 m (6.5') 5-Pin Mini QD	Polysulfone	120V ac	SPDT Electromechanical Relay
LTBA5L **LTBA5LQD**	2 m (6.5') 5-Pin Mini QD	Lexan®		
LTBB5 **LTBB5QD**	2 m (6.5') 5-Pin Mini QD	Polysulfone	220/240V ac	
LTBB5L **LTBB5LQD**	2 m (6.5') 5-Pin Mini QD	Lexan®		

WARNING...Banner OPTO-TOUCH OTB and LTB Series Optical Touch Buttons are intended as general-purpose switches, and are *not* safety devices. Like most solid-state devices, they are equally as likely to fail in the conducting ("ON") state as in the non-conducting ("OFF") state. They must be used with a two-hand control safety relay for machine initiation, wherever false operation of an OPTO-TOUCH switch could be dangerous. **Never use an OPTO-TOUCH Optical Touch Button as an actuator in an emergency (E-Stop) circuit.**

For OPTO-TOUCH Switches:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **OTBVN6 W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 537 and the Accessories section for more information.

OPTO-TOUCH Specifications

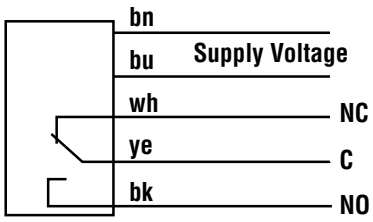
Supply Voltage and Current	**OTBVR81** models: 20 to 30V ac/dc **OTBA5** and **LTBA5** models: 105 to 130V ac **OTBB5** and **LTBB5** models: 210 to 250V ac **OTBVN6/VP6** models: 10 to 30V dc All models require less than 25 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	**OTBVR81, OTBA5, LTBA5, OTBB5** and **LTBB5** models: SPDT electromechanical relay **OTBVN6** models: Complementary (SPDT) NPN (sinking) open-collector transistor **OTBVP6** models: Complementary (SPDT) PNP (sourcing) open-collector transistors
Output Rating	Models with electromechanical relay: **Maximum switching current:** 7 amps (resistive load), 1 HP maximum **Minimum load:** 0.05 watts (dc), 0.05 VA (ac) **Mechanical life of relay:** 50,000,000 operations (minimum) **Electrical life of relay:** 100,000 operations (min.) at full resistive load Transient suppression is recommended when switching inductive loads Models with solid-state outputs: 150mA maximum load (each output) **On-state saturation voltage:** <1 volt at signal levels; <1.5 volts at full load **Off-state leakage current:** <1 microamp
Output Protection	All models protected against false pulse on power-up Models with solid-state outputs have overload and short circuit protection
Indicators	Two red indicator LEDs: one lights whenever power is applied; the other lights whenever the normally-open output is conducting
Construction	Totally encapsulated, non-metallic enclosure. Black polysulfone or red Lexan® polycarbonate upper housing (see Application Notes below); fiber-reinforced thermoplastic polyester base. Electronics fully epoxy-encapsulated. Supplied with a field cover of polypropylene (TP).
Environmental Rating	Meets NEMA standards 1, 3, 4, 4X, 12 and 13; IEC IP66
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or mini-style quick disconnect (QD) fitting are available. QD cables are ordered separately. See page 537 and the Accessories section.
Ambient Light Immunity	120,000 lux (direct sunlight)
EMI/RFI Immunity	Highly resistant to both single and mixed EMI and RFI noise sources
Operating Temperature	**Temperature:** -20° to +50° C (-4° to +122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	**Environmental Considerations for models with polysulfone upper housings:** The polysulfone upper housing will become embrittled with prolonged exposure to outdoor sunlight. Window glass effectively filters longer wavelength ultraviolet light and provides excellent protection from sunlight. **Environmental Considerations for models with Lexan® polycarbonate upper housings:** Avoid prolonged exposure to hot water and moist high-temperature environments above 66°C (150°F). Avoid contact with aromatic hydrocarbons (such as xylene and toluene), halogenated hydrocarbons and strong alkalis. Clean periodically using mild soap solution and a soft cloth. Avoid strong alkaline materials.
Certifications	CE CSA® UL LISTED

Lexan® is a registered trademark of General Electric Co.

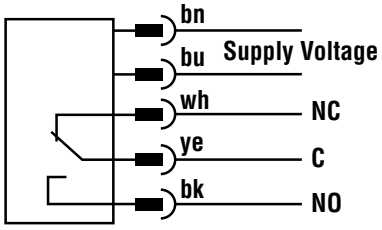
OPTO-TOUCH Hookup Diagrams

Models with Electromechanical Relay Output

Models with Attached Cable

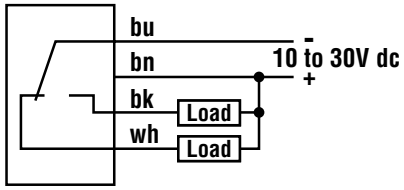


Models with Quick Disconnect 5-Pin Mini-Style

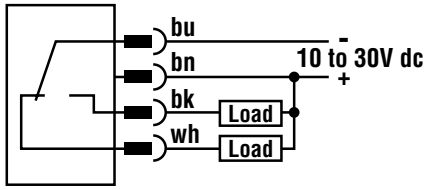


DC Models with Solid-State Outputs

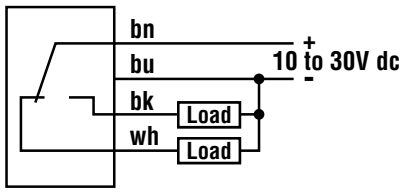
NPN (Sinking) Models with Attached Cable



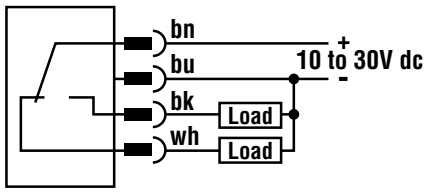
NPN (Sinking) Models with Quick Disconnect 4-Pin Mini-Style



PNP (Sourcing) Models with Attached Cable



PNP (Sourcing) Models with Quick Disconnect 4-Pin Mini-Style



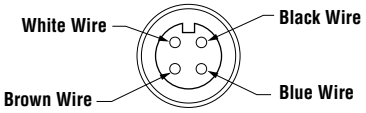
Quick Disconnect (QD) Option

OPTO-TOUCH switches are sold with either a 2 m (6.5') or a 9 m (30') attached PVC-covered cable, or with a 4- or 5-pin mini-style QD cable fitting.

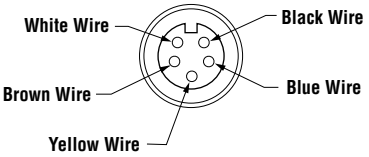
OPTO-TOUCH switches are identified by the letters “QD” in their model number suffix. Information on mating cables for QD OPTO-TOUCH switches can be found on page 537 and the Accessories section.

OPTO-TOUCH Hookup Diagrams

4-Pin Mini-Style Pin-out (Cable Connector Shown)

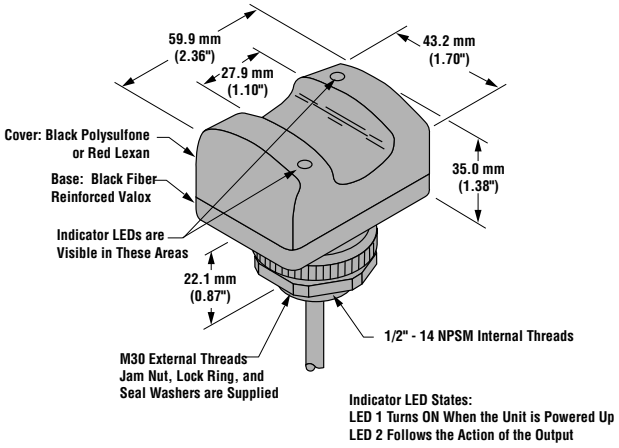


5-Pin Mini-Style Pin-out (Cable Connector Shown)

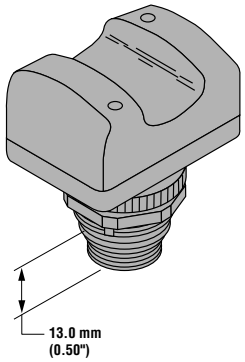


OPTO-TOUCH Dimensions

OPTO-TOUCH with Attached Cable



OPTO-TOUCH with Quick-Disconnect



Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All OPTO-TOUCH switches may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	OTBVN6 W/30

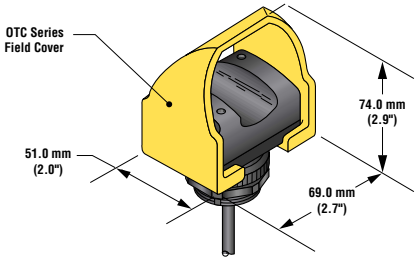
Quick-Disconnect (QD) Cables

Following is the selection of cables available for OPTO-TOUCH QD models. See the Accessories section for more cable information.

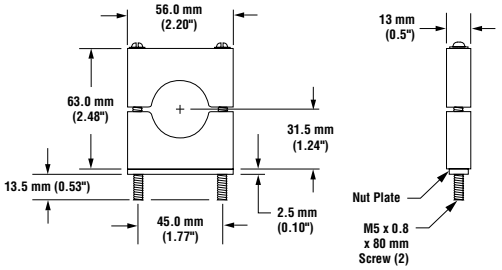
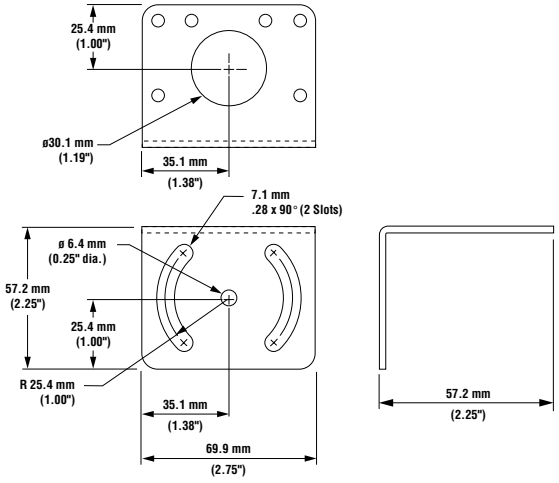
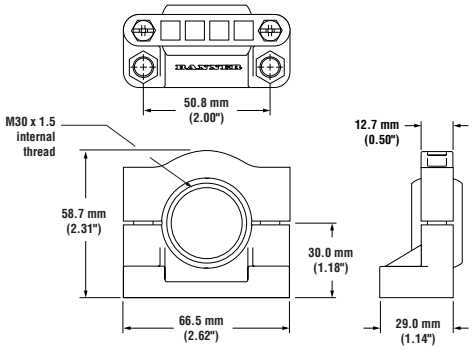
Style	Model	Length	Connector	Used with:
4-Pin Euro	**MQDC-406** **MQDC-415** **MQDC-430**	2 m (6.5') 5 m (15') 9 m (30')	Straight	All 10-30V dc OPTO-TOUCH QD models
4-Pin Mini	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')	Straight	All 10-30V dc OPTO-TOUCH QD models
5-Pin Mini	**MBCC-506** **MBCC-512** **MBCC-530**	2 m (6.5') 4 m (12') 9 m (30')	Straight	All OPTO-TOUCH QD models with electromechanical relay

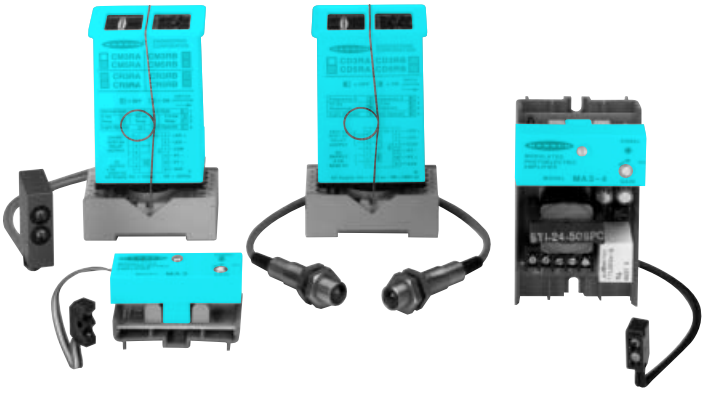
Field Covers

OPTO-TOUCH field covers are designed to prevent inadvertent activation of OPTO-TOUCHs due to objects (loose clothing, debris, etc.) which might accidentally block their sensing beam. Field covers are constructed of rugged polycarbonate-PET polyester blend and highly resistant to abrasion and to damage by most chemicals. NOTE: Each OPTO-TOUCH is supplied with a black field cover.

Model	Description		
OTC-1-BK **OTC-1-GN** **OTC-1-RD** **OTC-1-YW**	Black cover Green cover Red cover Yellow cover		

Mounting Brackets

Model	Description	Dimensions
SMB30C 	• 30 mm split clamp, black thermoplastic polyester bracket • Stainless steel mounting hardware included	
SMB30MM 	• 30 mm, 11-gauge, stainless steel bracket with curved mounting slots for versatility and orientation • Clearance for M6 (1/4") hardware	
SMB30SC 	• 30 mm swivel, black reinforced thermoplastic polyester bracket • Stainless steel mounting hardware included	



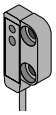
Remote Sensors and Component Systems

Remote Sensors & Component Systems are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

Remote Sensors

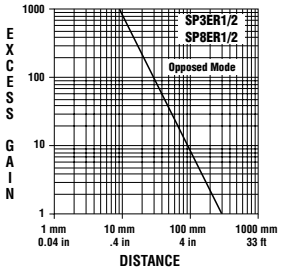
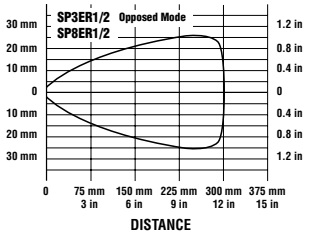
- SP3, SP8, and SP100 Series sensors are ultra-miniature for mounting in extremely tight areas of automated machinery; they wire using thin, highly-flexible cable
- SP12 Series opposed mode remote sensors are 12 mm barrel sensors available in thermoplastic polyester or stainless steel and are designed for severe industrial duty, including high-pressure washdowns typically found in food processing applications
- All sensors (except model SP1000V) are epoxy-encapsulated, and most models feature hermetically-sealed optics
- Choose compact PICO-AMP and MICRO-AMP amplifiers, or full-featured MAXI-AMP amplifiers

Remote Sensors Sensing Mode Options



Infrared, 900 nm

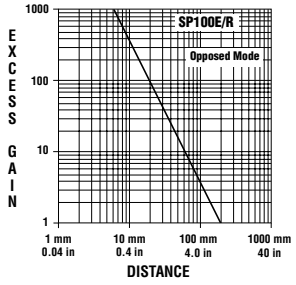
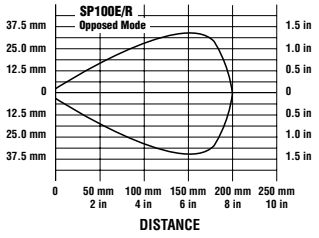
Remote Sensors Opposed Mode*

Models*	Range	Housing	Cable	Temperature	Compatible Amplifiers	Excess Gain	Beam Pattern
SP3ER1 p. 546 **SP3ER2** p. 546 **SP8ER1** p. 546 **SP8ER2** p. 546	300 mm (12")	Black ABS	Parallel Coaxial 2 m (6.5')	-20° to +70°C (-5° to +158°C)	PICO-AMP: MD14BB6 MD14BB6Q		Effective Beam = 1.5 mm 

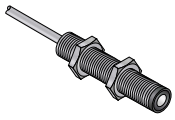
*NOTE: Opposed-mode sensors are shipped in connected pairs (one emitter and one receiver). The emitter includes a yellow LED which is ON whenever the receiver senses light from its emitter. The housing of the receiver will be the "mirror image" of its corresponding emitter. See dimension drawings on page 546 for details of the differences between models.

Infrared, 880 nm

Remote Sensors Opposed Mode Emitters (suffix E) and Receivers (suffix R)

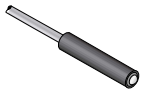
Models	Range	Housing	Cable	Temperature	Compatible Amplifiers	Excess Gain	Beam Pattern
SP100E p. 546	200 mm (8")	Thermo-plastic polyester	2-wire ribbon 2 m (6.5')	0° to +70°C (+32° to 158°F)	MICRO-AMP: MA3 MA3P MPC3 MAXI-AMP: CR Series		Effective Beam: 1.3 mm 
SP100R p. 546			3-wire ribbon 2 m (6.5')				

Infrared, 880 nm

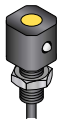


LR400/PT400

LR300/PT300

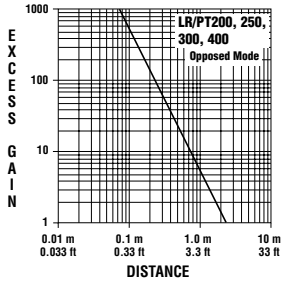
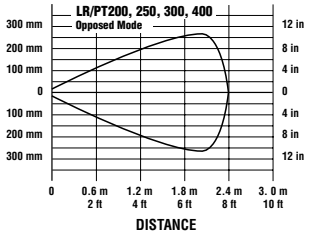


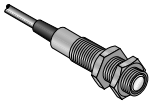
LR250/PT250



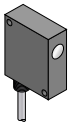
LR200/PT200

Remote Sensors Opposed Mode Emitters (prefix LR) and Receivers (prefix PT)

Models	Range	Housing	Cable	Temperature	Compatible Amplifiers	Excess Gain	Beam Pattern
LR200 PT200 p. 546	2.4 m (8')	DELRIN®	2-wire shielded 2 m (6.5')	-40° to +100°C (-40° to +212°F)	MICRO-AMP: MA3-4 MA3-4P MAXI-AMP: CM Series		Effective Beam: 3.6 mm 
LR250 PT250 p. 547		DELRIN®					
LR300 PT300 p. 547		Thermo-plastic polyester		-40° to +80°C (-40° to +176°F)			
LR400 PT400 p. 547		Anodized aluminum		-40° to +100°C (-40° to +212°F)			



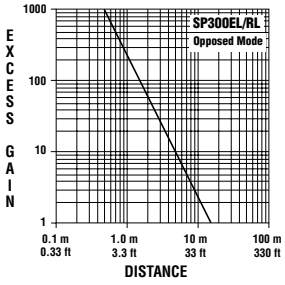
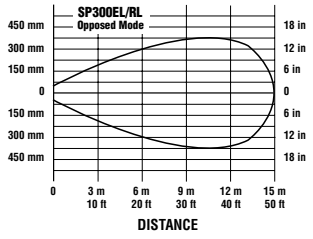
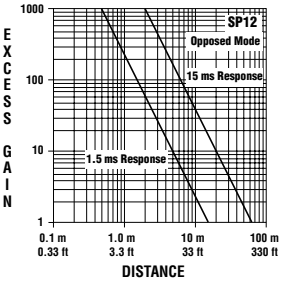
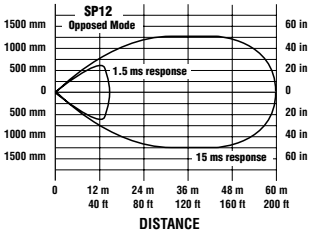
SP12s

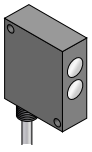


SP300EL/RL

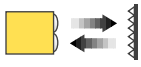
Infrared, 880 nm

Remote Sensors Opposed Mode Emitters (suffix EL) and Receivers (suffix RL)

Models	Range	Housing	Cable	Temperature	Compatible Amplifiers	Excess Gain	Beam Pattern
SP300EL p. 547	15 m (50')	Anodized aluminum	2-wire shielded 2 m (6.5')	-40° to +100°C (-40° to +212°F)	MICRO-AMP: MA3-4 MA3-4P MAXI-AMP: CM Series		Effective Beam:13 mm 
SP300RL p. 547							
SP12PEL **SP12PRL** p. 547	60 m (200')	Thermo-plastic polyester	2-wire emitter 3-wire receiver 2 m (6.5')	-40° to +70°C (-40° to +158°F)	MAXI-AMP: CD Series		Effective Beam: 9.5 mm 
SP12SEL **SP12SRL** p. 547		Stainless steel	2-wire emitter 3-wire receiver 2 m (6.5')				
SP12SELQD **SP12SRLQD** p. 547		Stainless steel	4-Pin Euro QD				

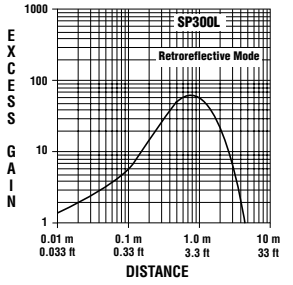
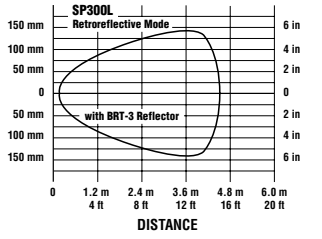


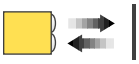
NOTE: Retroreflective range is specified using one model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending upon the efficiency and reflective area of the retroreflector(s) in use. See page 722 for more information.



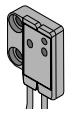
Infrared, 880 nm

Remote Sensors Non-Polarized Retroreflective Mode

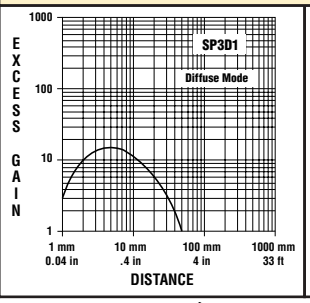
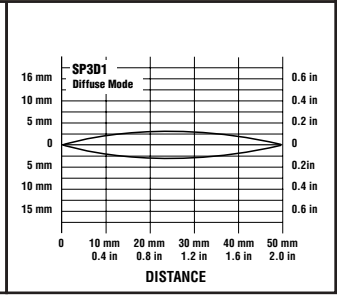
Models	Range	Housing	Cable	Temperature	Compatible Amplifiers	Excess Gain	Beam Pattern
SP300L p. 548	4.5 m (15')	Anodized aluminum	4-wire shielded 2 m (6.5')	-40° to +80°C (-40° to +176°F)	MICRO-AMP: MA3-4 MA3-4P MAXI-AMP: CM Series		

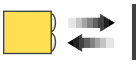


Infrared, 900 nm



Remote Sensors Diffuse Mode

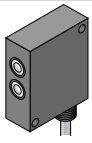
Models	Range	Housing	Cable	Temperature	Compatible Amplifiers	Excess Gain	Beam Pattern
						Performance based on 90% reflectance white test card	
SP3D1 p. 546	50 mm (1.9")	Black ABS	Parallel Coaxial 2 m (6.5')	-20° to 70°C (-5° to +158°C)	PICO-AMP: MD14BB6 MD14BB6Q		



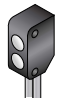
Infrared, 880 nm

SP100D

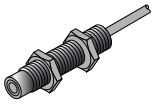
SP100DB



SP300D

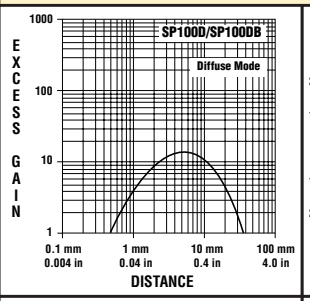
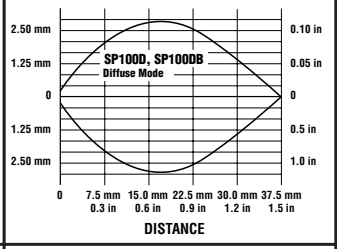
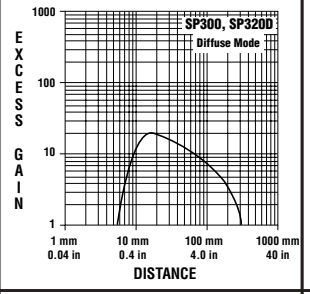
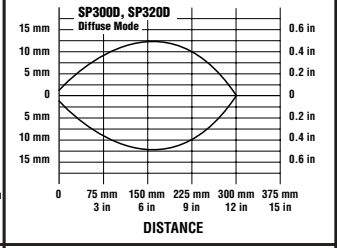
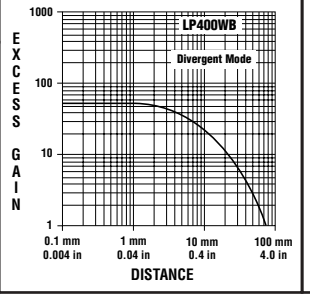
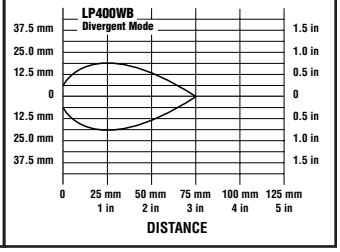


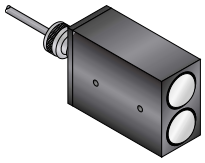
SP320D



LP400WB

Remote Sensors Diffuse Mode

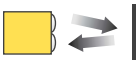
Models	Range	Housing	Cable	Temperature	Compatible Amplifiers	Excess Gain	Beam Pattern
						Performance based on 90% reflectance white test card	
SP100D p. 548	38 mm (1.5")	Thermo-plastic polyester	5-wire ribbon 2 m (6.5')	0°C to +70°C (+32° to 158°F)	MICRO-AMP: MA3 MA3P MPC3 MAXI-AMP: CR Series		
SP100DB p. 548		DELRIN®					
SP300D p. 548	300 mm (12")	Anodized aluminum	4-wire shielded 2 m (6.5')	-40° to +80°C (-40° to +176°F)	MICRO-AMP: MA3-4 MA3-4P MAXI-AMP: CM Series		
SP320D p. 548		Thermo-plastic polyester					
Divergent Diffuse							
LP400WB p. 548	76 mm (3")	Anodized aluminum	4-wire shielded 2 m (6.5')	-40° to +80°C (-40° to +176°F)	MICRO-AMP: MA3-4 MA3-4P MAXI-AMP: CM Series		



SP1000V

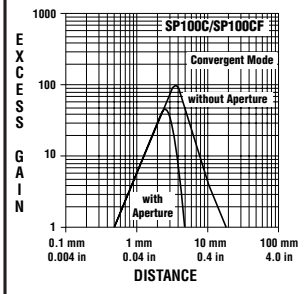
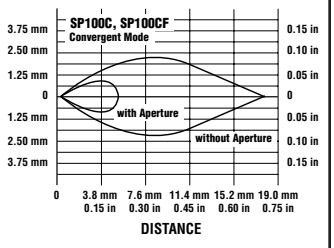
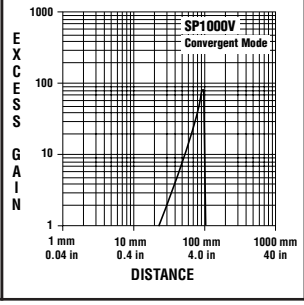
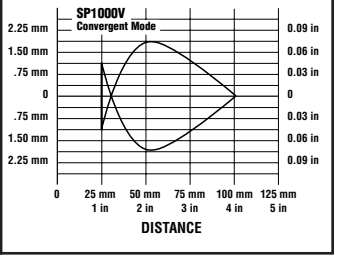
SP100CCF

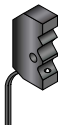
SP100C

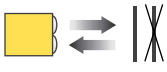


Infrared, 880 nm

Remote Sensors Convergent Mode

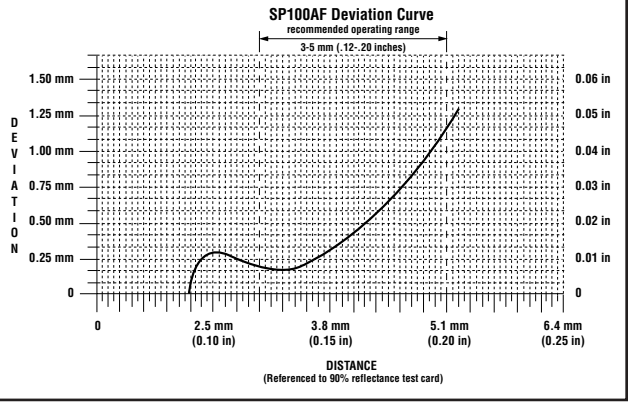
Models	Focus	Housing	Cable	Temperature	Compatible Amplifiers	Excess Gain	Beam Pattern
						Performance based on 90% reflectance white test card	
SP100C p. 549	2.5 mm (0.1")	Thermo-plastic polyester	5-wire ribbon 2 m (6.5')	0° to +70°C (+32° to 158°F)	MICRO-AMP: MA3 MA3P MPC3 MAXI-AMP: CR Series		
SP100CCF p. 549							
SP1000V p. 549	96 mm (3.8") Spot Size at Focus: 2.5 mm (0.1")	Anodized aluminum	4-wire shielded 2 m (6.5')	-40° to +80°C (-40° to +176°F)	MICRO-AMP: MA3-4 MA3-4P MAXI-AMP: CM Series		



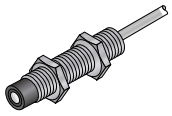


Infrared, 880 nm

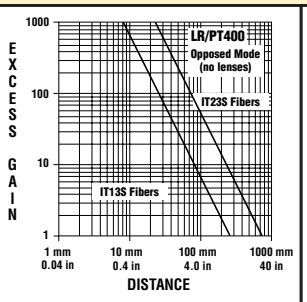
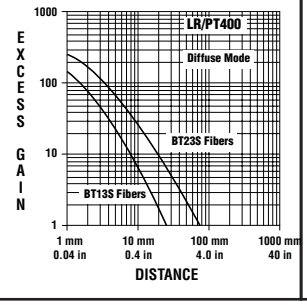
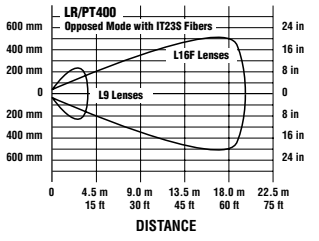
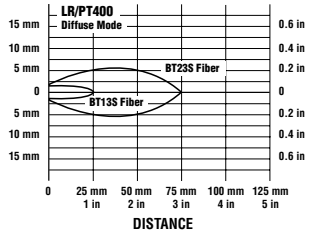
Remote Sensors Adjustable Field Mode

Models	Crossover Point	Housing	Cable	Temperature	Compatible Amplifiers	Deviation Curve
SP100AF p. 549	2.5 - 4.8 mm (0.10 - 0.19") adjustable with amplifier setting	DELRIN®	4-wire 2 m (6.5')	0° to +70°C (+32° to 158°F)	MICRO-AMP: MA3AF	

Infrared, 880 nm

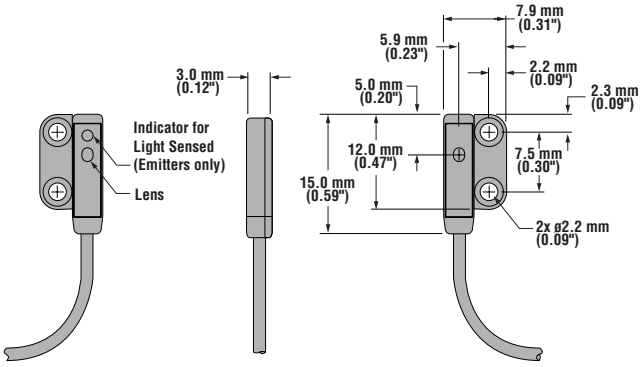


Remote Sensors Glass Fiber Optic

Models	Range	Housing	Cable	Temperature	Compatible Amplifiers	Excess Gain	Beam Pattern
						Diffuse mode performance based on 90% reflectance white test card	
LR400 PT400 with (2) FOF-400 fittings p. 547 and p. 587	Range varies by sensing mode and fiber optics used	Anodized aluminum	2-wire shielded 2 m (6.5')	-40° to +100°C (-40° to +212°F)	MICRO-AMP: MA3-4 MA3-4P MAXI-AMP: CM Series	 	 

Remote Sensors Dimensions

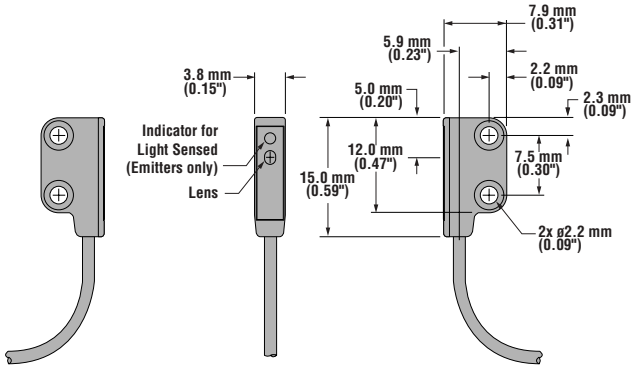
SP3ER Remote Sensors Opposed Mode



SP3E1 Emitter
(or SP3R2 Receiver)

SP3R1 Receiver
(or SP3E2 Emitter)

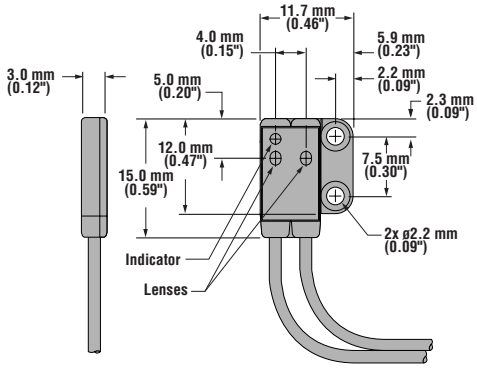
SP8ER Remote Sensors Opposed Mode



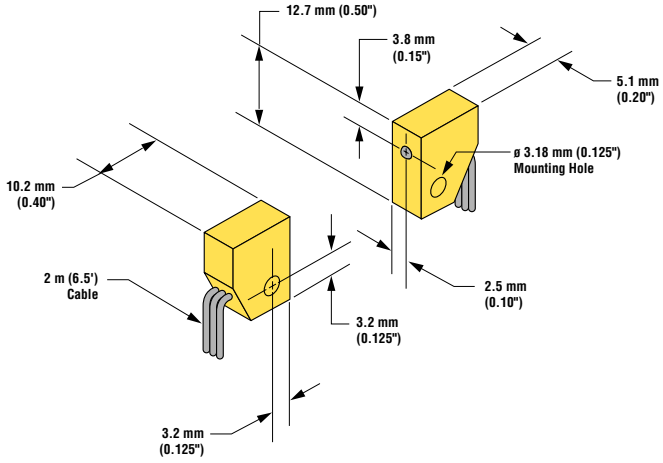
SP8E1 Emitter
(or SP8R2 Receiver)

SP8R1 Receiver
(or SP8E2 Emitter)

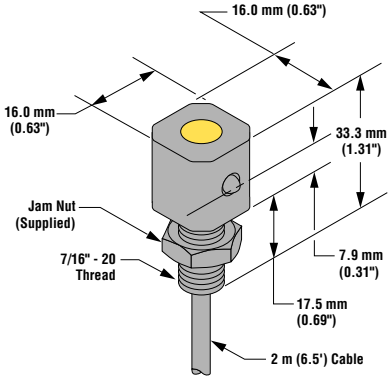
SP3D1 Remote Sensors Diffuse Mode



SP100E/R Remote Sensors Opposed Mode

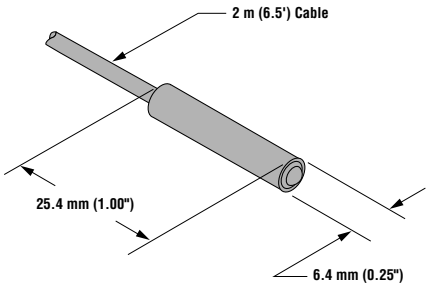


LR200/PT200 Remote Sensors Opposed Mode

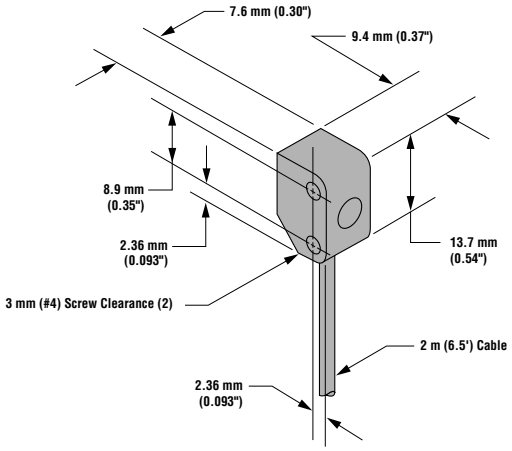


Remote Sensors Dimensions

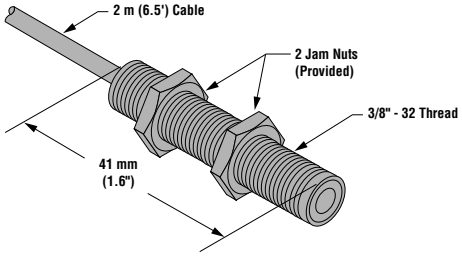
LR250/PT250 Remote Sensors Opposed Mode



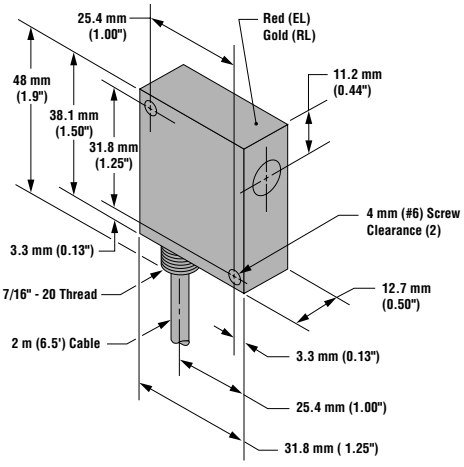
LR300/PT300 Remote Sensors Opposed Mode



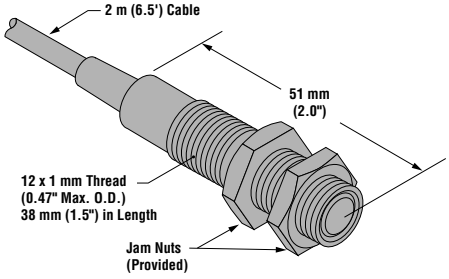
LR400/PT400 Remote Sensors Opposed Mode



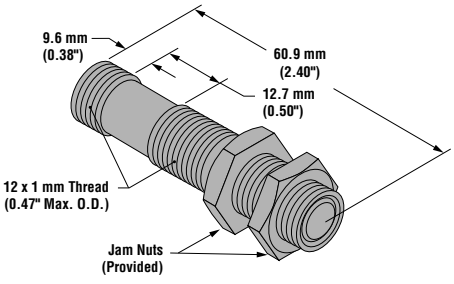
SP300EL/RL Remote Sensors Opposed Mode



SP12 Series Remote Sensors with Cable Attached Opposed Mode

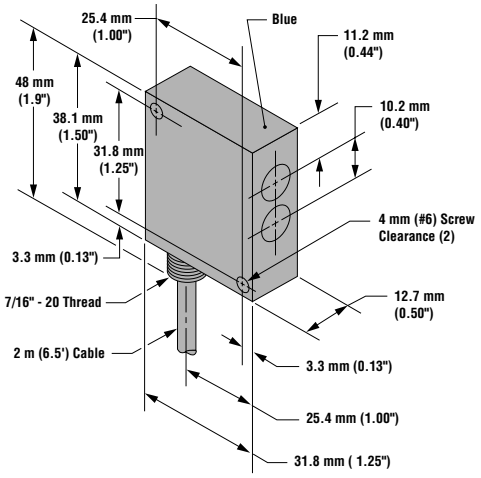


SP12 Series Remote Sensors with Quick-Disconnect Opposed Mode 4-Pin Euro-Style

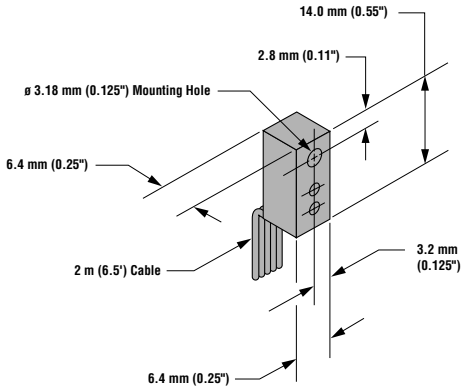


Remote Sensors Dimensions

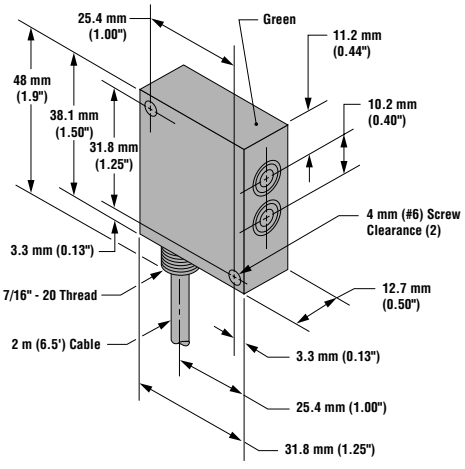
SP300L Remote Sensor Retroreflective Mode



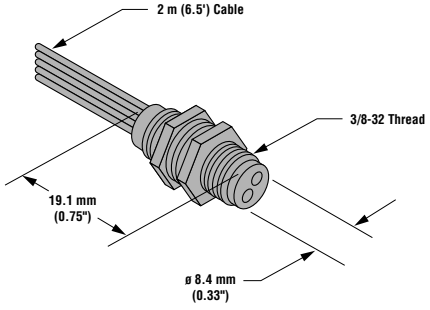
SP100D Remote Sensor Diffuse Mode



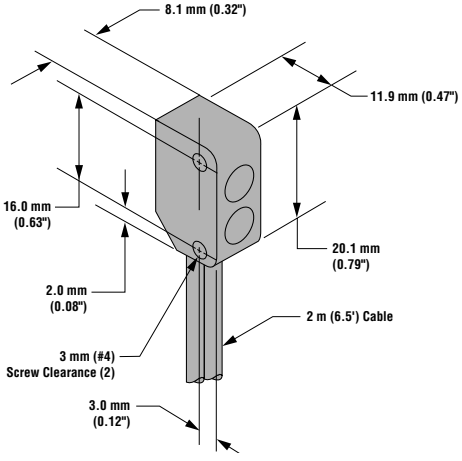
SP300D Remote Sensor Diffuse Mode



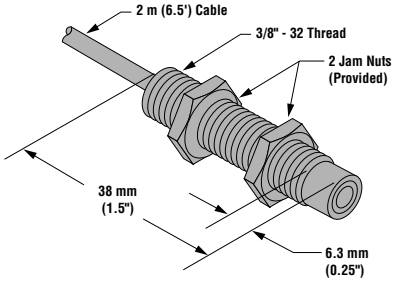
SP100DB Remote Sensor Diffuse Mode



SP320D Remote Sensor Diffuse Mode

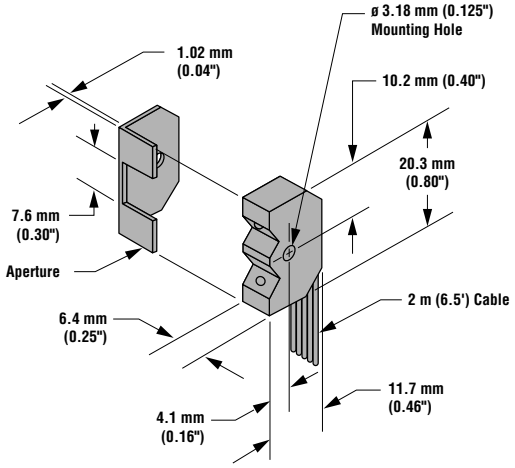


LP400WB Remote Sensor Divergent Diffuse Mode

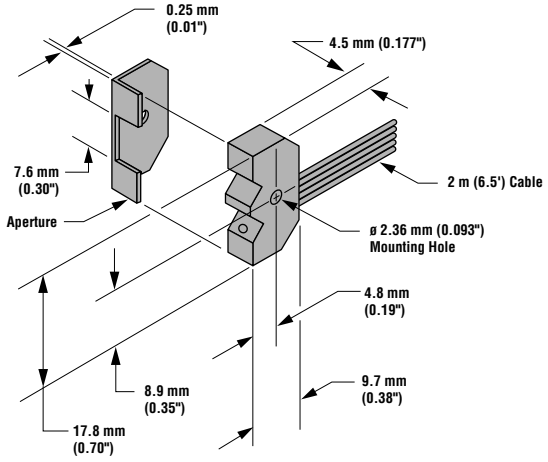


Remote Sensors Dimensions

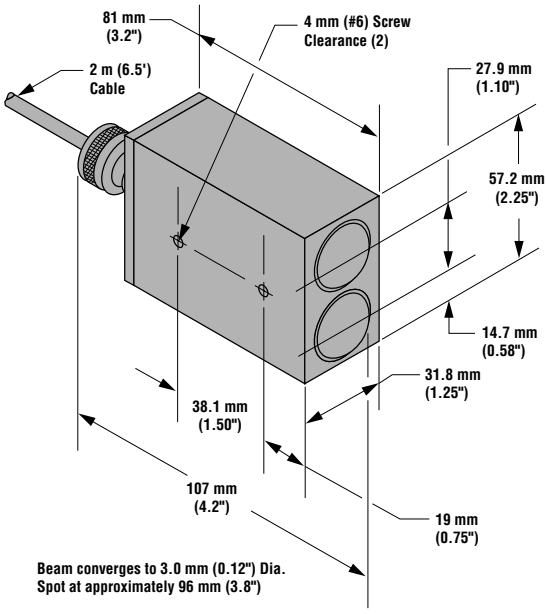
SP100C Remote Sensors Convergent Mode



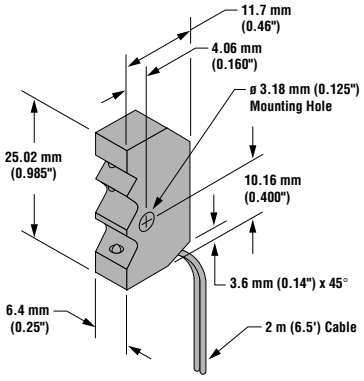
SP100CCF Remote Sensors Convergent Mode



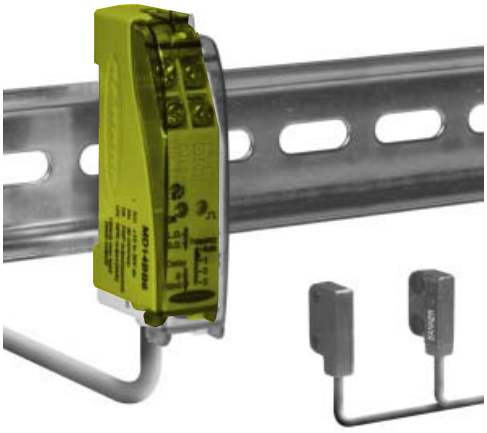
SP1000V Remote Sensor Convergent Mode



SP100AF Remote Sensor Adjustable Field Mode



PICO-AMP MD14 Series Amplifier Modules



*U.S. Patent #4356393

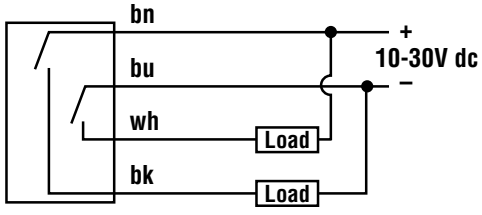
- Ultra-small remote sensors to fit the tightest locations
- Three fixed frequency selections or Auto Frequency mode to prevent crosstalk in multiple-sensor applications
- Amplifier clips to 35 mm DIN rail for easy mounting
- Diffuse- or opposed-mode sensors are available
- Opposed-mode sensors are sold in pairs
- Opposed-mode range is 300 mm; diffuse-mode range is 50 mm
- Amplifiers and sensors are sold separately
- Yellow indicator on emitter signals when light is sensed; Yellow indicator on amplifier signals light sensed and flashes to indicate marginal excess gain (between 1.0 and 1.5x)
- An excellent option for wafer handling applications, small parts sensing and pharmaceutical applications

PICO-AMP MD14 Series Amplifier Modules

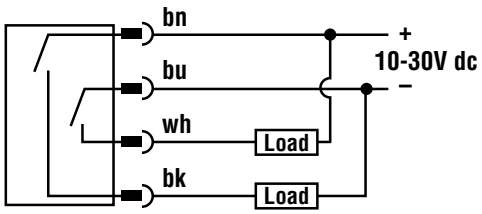
Models	Supply Voltage	Response	Output Saturation	Off-State Leakage	Compatible Sensors	Output Type
MD14BB6 **MD14BB6Q**	10 to 30V dc	See Specifications	PNP Output: <1V at 10 mA; <1.5V at 100 mA NPN Output: <0.2V at 10 mA; <0.75V at 100 mA	<5 µA	SP3ER1 SP3ER2 SP8ER1 SP8ER2 SP3D1 See p. 540	Bipolar, NPN/PNP

PICO-AMP MD14 Amplifier Hookup Diagrams

With Attached Cable



With Quick-Disconnect



PICO-AMP MD14 Amplifier Specifications

Sensor compatibility	PICO-AMP amplifier models MD14BB6 and MD14BB6Q are compatible with the following remote sensors: SP3ER1, SP3ER2, SP8ER1, SP8ER2, SP3D1 (see p. 540)
Supply voltage and current	10 to 30V dc (10% maximum ripple) at less than 55 mA (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages.
Output Configuration	Bipolar, one current sourcing (PNP) and one current sinking (NPN) open-collector transistor
Output Rating	100mA maximum, each output **Off-state Leakage Current:** less than 5µA **Output Saturation Voltage:** **PNP output** less than 1V @10mA; less than 1.5V @ 100mA **NPN output** less than 0.2V @ 10mA; less than 0.75V @ 100mA
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short-circuit of outputs
Output Response Time	**Frequency Selection** — **Response Time** Auto — 500 µs ON/ 350 µs OFF Freq 1 — 350 µs ON/ 250 µs OFF Freq 2 — 450 µs ON/ 300 µs OFF Freq 3 — 500 µs ON/ 350 µs OFF NOTE 1: Auto mode defaults to Freq 1 at power-up NOTE 2: Response time will increase with adjacent sensor interference.
Adjustments/programming	Light/Dark Operate Select switch OFF-delay Select switch: 0 or 50 ms 4-position Frequency Select switch: Auto, Freq 1, Freq 2, Freq 3 12-turn slotted brass screw Gain (Sensitivity) adjustment potentiometer (clutched at both ends of travel)
Indicators	**Green:** ON Steady = Power to amplifier is ON Flashing = Output is overloaded **Yellow:** ON Steady = Light is sensed Flashing = Marginal excess gain (1 to 1.5x) in light condition
Construction	**Housing:** Yellow polycarbonate/ABS alloy, rated UL94 V-0 **Cover:** Gray-tinted polycarbonate **DIN spring clip:** Yellow Delrin® (acetal)
Environmental Rating	IP50, NEMA 1
Connections	**Sensor(s):** four M2.5 zinc-plated steel SEMS screws **Power and Outputs:** PVC-jacketed 4-conductor 2 m (6.5') or 9 m (30') attached cable, or 4-pin Pico-style quick-disconnect fitting QD cables are ordered separately (see Accessories)
Operating Conditions	**Temperature:** 0° to 55° C (32° to 131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Always remove power to amplifier before connecting or disconnecting sensors.
Certifications	CE

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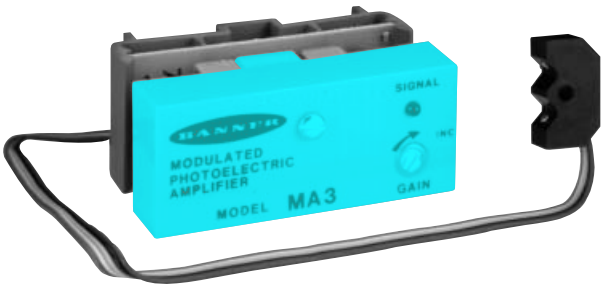
MICRO-AMP MA3 Series Amplifier Modules



†U.S. Patent #4356393

- DC photoelectric amplifier modules designed around the concept of an I/O module; they integrate perfectly with programmable logic controllers (PLCs)
- Models MA3 and MA3P work with the SP100 Series of sub-miniature remote sensors
- Two complementary outputs: one normally open and one normally closed
  - Model MA3: open-collector NPN (sinking) transistors
  - Model MA3P: open-collector PNP (sourcing) transistors
- Features Banner's exclusive† AID™ (Alignment Indicating Device) signal strength indicating system for sensor alignment and monitoring
- 1-millisecond output response
- Totally-encapsulated solid-state circuitry; gold-flashed connector pins
- May be mounted directly to a printed circuit board, or wired using optional RS8 socket or MPS-15 power supply (see Accessories, pages 591 and 592)

MICRO-AMP MA3 Series Amplifier Modules

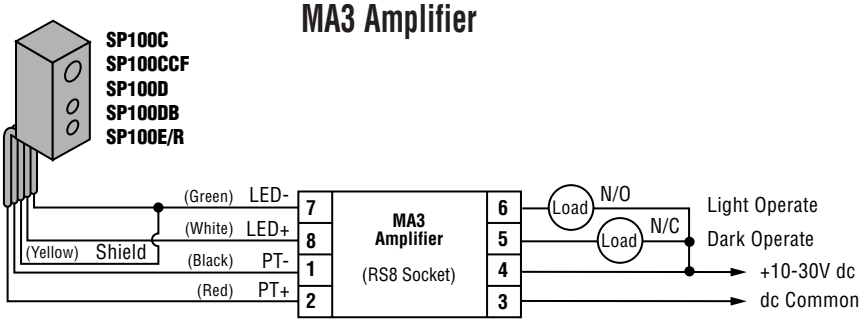
Models	Supply Voltage	Response	Repeatability of Response	Output Saturation	Off-State Leakage	Compatible Sensors	Output Type
MA3	10 to 30V dc	1 ms on/off	0.3 milliseconds	<0.5 V dc at 10 mA	<1 µA	SP100 Series (except SP100 AF) See pp. 541, 543, and 544	Complementary (SPDT) NPN transistors
MA3P				<1V at 10 mA			Complementary (SPDT) PNP transistors

MICRO-AMP MA3 Series Amplifier Specifications

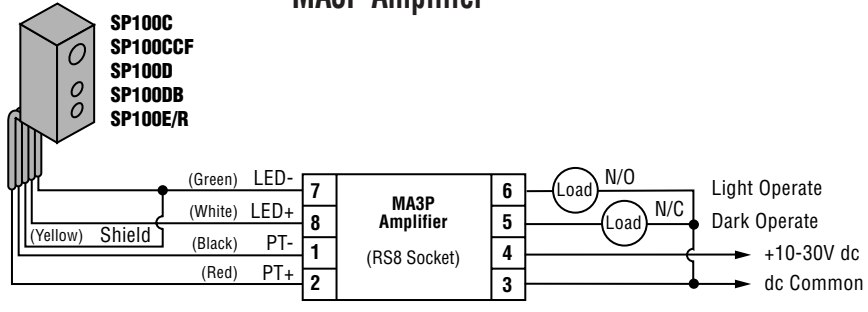
Sensor Compatibility	MICRO-AMP amplifier models MA3 and MA3P are compatible with the following remote sensors: - SP100E and SP100R (see pp. 541, 543 and 544) - SP100D - SP100DB - SP100C - SP100CCF
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 20 mA (exclusive of load)
Output Configuration	MA3: Two complementary (SPDT) open-collector NPN (current sinking) transistors MA3P: Two complementary (SPDT) open-collector PNP (current sourcing) transistors
Output Rating	150 mA maximum each output **Off-state leakage current** less than 1 microamp **Output saturation voltage:** Model MA3: (both outputs) less than 0.5V dc at 10 mA load Model MA3P: (both outputs) less than 1V dc at 10 mA load
Output Response Time	1 millisecond on and off
Repeatability	0.3 milliseconds
Adjustments	GAIN (Sensitivity) adjustment is a single-turn potentiometer; adjust with small flat-blade screwdriver
Indicators	SIGNAL (red) AID™ System LED lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the received signal
Construction	Molded thermoplastic polyester housing with totally encapsulated circuitry; gold-flashed connection pins; may be mounted directly to printed circuit board or wired using optional RS8 socket or MPS-15 power supply (see Accessories, pages 591 and 592)
Operating Conditions	**Temperature:** 0° to +70°C (+32° to 158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Limit sensor cable length to 4.5 m (15')

MA3 Series Amplifier Hookup Diagrams

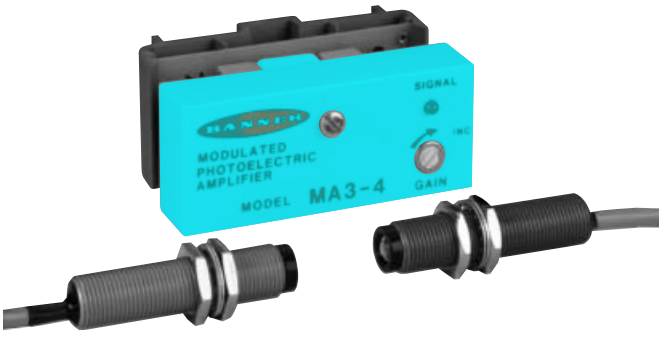
MA3 Amplifier



MA3P Amplifier



MICRO-AMP MA3-4 Series Amplifier Modules



†U.S. Patent #4356393

- DC photoelectric amplifier modules designed around the concept of an I/O module; they integrate perfectly with programmable logic controllers (PLCs)
- Models MA3-4 and MA3-4P are higher-gain amplifiers which are used with Banner's complement of high-performance modulated remote sensors
- Two complementary outputs: one normally open and one normally closed
  - Model MA3-4: open-collector NPN (sinking) transistor
  - Model MA3-4P: open-collector PNP (sourcing) transistor
- Features Banner's exclusive† AID™ (Alignment Indicating Device) signal strength indicating system for sensor alignment and monitoring
- 1-millisecond output response
- Totally-encapsulated solid-state circuitry; gold-flashed connector pins
- May be mounted directly to a printed circuit board, or wired using optional RS8 socket or MPS-15 power supply (see Accessories, pages 591 and 592)

MICRO-AMP MA3-4 Series Amplifier Modules

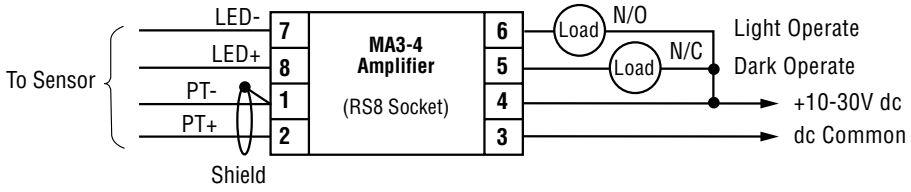
Models	Supply Voltage	Response	Repeatability of Response	Output Saturation	Off-State Leakage	Compatible Sensors	Output Type
MA3-4	10 to 30V dc	1 ms on/off	0.3 milliseconds	<0.5 V dc at 10 mA	<1 µA	LR Series PT Series SP300EL/RL SP300L SP300D SP320D LP400WB SP1000V See pp. 541-545	Complementary (SPDT) NPN transistors
MA3-4P				<1V at 10 mA			Complementary (SPDT) PNP transistors

MICRO-AMP MA3-4 Series Amplifier Specifications

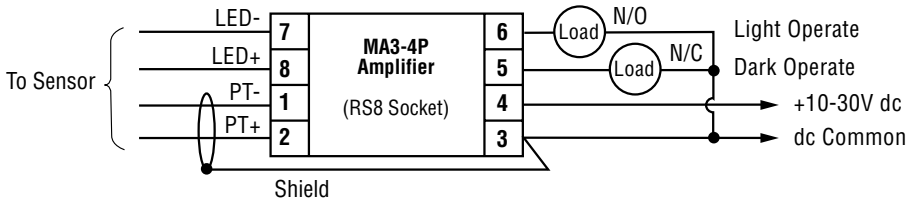
Sensor Compatibility	MICRO-AMP amplifier models MA3-4 and MA3-4P are compatible with the following remote sensors: - LR200 and PT200 - SP300L (see pp. 541-545) - LR250 and PT250 - SP300D - LR300 and PT300 - SP320D - LR400 and PT400 - SP400WB -SP300EL and SP300RL - SP1000V
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 20 mA (exclusive of load)
Output Configuration	MA3-4: Two complementary (SPDT) open-collector NPN (current sinking) transistors MA3-4P: Two complementary (SPDT) open-collector PNP (current sourcing) transistors
Output Rating	150 mA maximum each output **Off-state leakage current** less than 1 microamp **Output saturation voltage:** Model MA3-4: (both outputs) less than 0.5V dc at 10 mA load Model MA3-4P: (both outputs) less than 1V dc at 10 mA load
Output Response Time	1 millisecond on and off
Repeatability	0.3 milliseconds
Adjustments	GAIN (Sensitivity) adjustment is a single-turn potentiometer; adjust with small flat-blade screwdriver
Indicators	SIGNAL (red) AID™ System LED lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the received signal
Construction	Molded thermoplastic polyester housing with totally encapsulated circuitry; gold-flashed connection pins; may be mounted directly to printed circuit board or wired using optional RS8 socket or MPS-15 power supply (see Accessories, pages 591 and 592)
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Limit sensor cable length to 9 m (30')

MA3-4 Series Amplifier Hookup Diagrams

MA3-4 Amplifier



MA3-4P Amplifier



MICRO-AMP MA3AF Amplifier Modules

- Model MA3AF is a specially-designed differential mode amplifier for use with model SP100AF adjustable-field sensor
- Two complementary outputs: one normally open and one normally closed
- 4-turn potentiometer for maximum range adjustment
- 10-millisecond output response
- Totally-encapsulated solid-state circuitry; gold-flashed connector pins
- May be mounted directly to a printed circuit board, or wired using optional RS8 socket or MPS-15 power supply (see Accessories, pages 591 and 592)

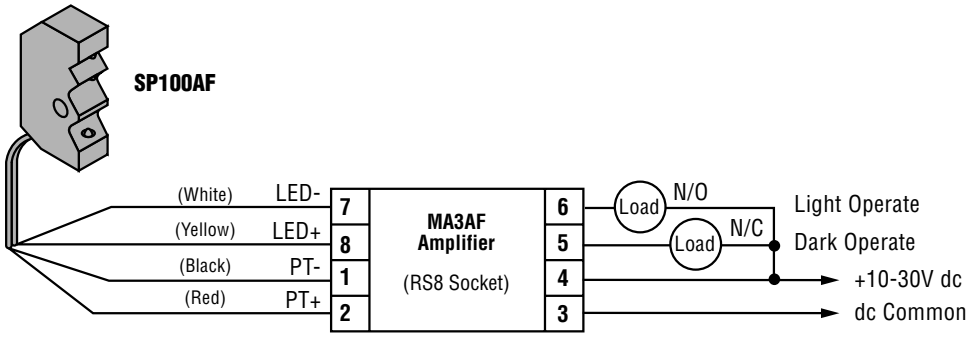
MICRO-AMP MA3AF Amplifier Module

Models	Supply Voltage	Response	Output Saturation	Off-State Leakage	Compatible Sensors	Output Type
MA3AF	10 to 30V dc	10 ms on/off	<0.5 V dc at 10 mA	<1 µA	SP100AF See p. 544	Complementary (SPDT) NPN transistors

MICRO-AMP MA3AF Amplifier Specifications

Sensor Compatibility	MICRO-AMP amplifier model MA3AF is compatible with remote sensor model SP100AF, p. 544.
Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 20 mA (exclusive of load)
Output Configuration	Two complementary (SPDT) open-collector NPN (current sinking) transistors
Output Rating	150 mA maximum each output **Off-state leakage current** less than 1 microamp **Output saturation voltage:** (both outputs) less than 0.5V dc at 10 mA load
Output Response Time	10 milliseconds on and off (NOTE: 100 millisecond delay on power-up: outputs are non-conducting during this time.)
Repeatability	1.6 milliseconds
Adjustments	4-turn potentiometer for maximum range adjustment; adjust with small flat-blade screwdriver
Indicators	SIGNAL (red) LED lights whenever the sensor sees its modulated light source
Construction	Molded thermoplastic polyester housing with totally encapsulated circuitry; gold-flashed connection pins; may be mounted directly to printed circuit board or wired using optional RS8 socket or MPS-15 power supply (see Accessories, pages 591 and 592)
Operating Conditions	**Temperature:** 0° to +70°C (+32° to 158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)

MA3AF Amplifier Hookup Diagram



MICRO-AMP MPC3 Amplifier Modules

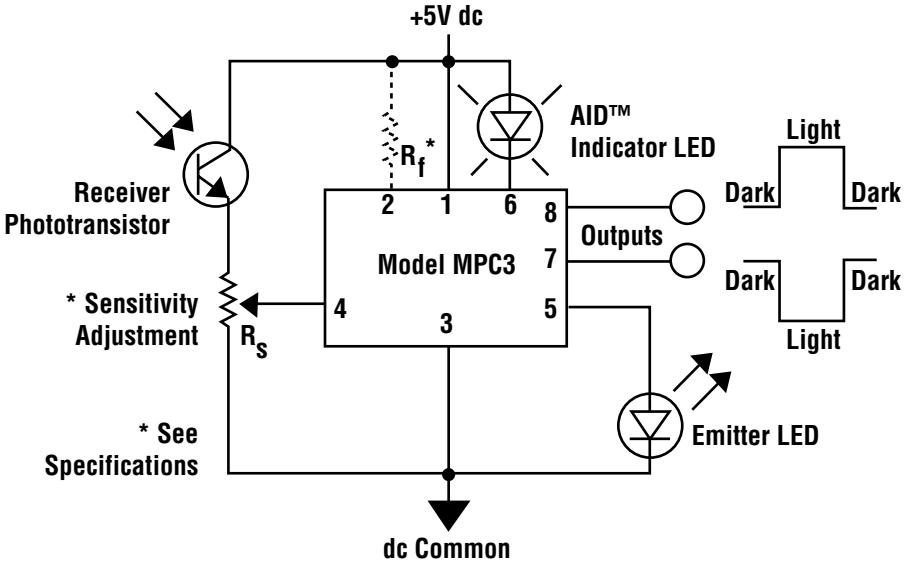
†U.S. Patent #4356393

- 5V dc model MPC3 is specifically designed for mounting directly onto printed circuit boards in OEM sensing applications
- Used together with the SP100 Series of sub-miniature remote sensors
- Complementary outputs are conventional CMOS buffered gates
- Features Banner's exclusive† AID™ (Alignment Indicating Device) signal strength indicating system for sensor alignment and monitoring (LED is supplied by customer)
- Sensing response time is adjustable downward from 10 milliseconds
- Supplied with set of eight closed-end jacks for printed circuit board plug-in mounting

MICRO-AMP MPC3 Amplifier Module

Models	Supply Voltage	Response	Repeatability of Response	Compatible Sensors	Output Type
MPC3	5V dc ±10%	10 ms on/off (see specifications)	2.5 milliseconds	SP100 Series (except SP100AF) See pp. 541, 543 and 544	Complementary (SPDT) buffered CMOS gates

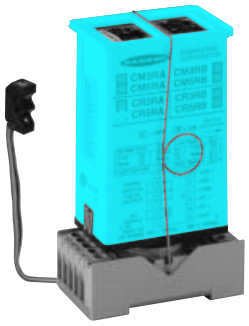
MPC3 Amplifier Hookup Diagram



MICRO-AMP MPC3 Amplifier Specifications

Sensor Compatibility	MICRO-AMP amplifier model MPC3 is compatible with the following remote sensors: - SP100E and SP100R (see pp. 541, 543 and 544) - SP100D - SP100DB - SP100C - SP100CCF
Supply Voltage and Current	5V dc ±10% (100 millivolts maximum ripple) at less than 20 mA (exclusive of load)
Output Configuration	The outputs at pins #7 and #8 are conventional CMOS buffered gates. The output at pin #7 is high in the dark condition and low in the light condition. The output at pin #8 is low in the dark condition and high in the light condition.
Output Rating	Both outputs will source or sink several milliamps
Circuit Protection	Outputs are short circuit protected. They may be shorted to either the positive or negative supply line without damage. The emitter output at pin #5 is internally current-limited, and may be grounded indefinitely. The AID™ output at pin #6 is internally current-limited, and may be connected to the positive supply indefinitely.
Output Response Time	10 milliseconds on and off Faster response times are possible by installing a resistor ("Rf" in the he hookup diagram) from pin #2 to the positive supply (pin #1). The approximate value of Rf is 390KΩ for 5 millisecond response, and 39KΩ for 1 millisecond response. NOTE: Faster response reduces the available excess gain and resultant sensor range
Repeatability	2.5 milliseconds (with Rf = 390KΩ)
Adjustments	2,000Ω (2kΩ) is the optimum value for a potentiometer or fixed resistor when Banner sensors are used
Indicators	AID™ System LED (customer supplied) lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the received light signal. Current is held to only a few milliamps in order to minimize power supply requirements. If the indicator LED does not appear bright enough, Banner can suggest high-brightness LEDs.
Construction	Totally encapsulated circuitry in molded high-impact polystyrene housing
Connections	Closed-end jacks for printed circuit board plug-in mounting are included
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Limit sensor cable length to 4.5 m (15') Supply voltage must not exceed 6V dc or be connected in reverse polarity Install a 0.1 µF capacitor as close as possible to the supply pins of the MPC3 (pins #1 and #3) if voltage transients are anticipated

MAXI-AMP CR Series Amplifier Modules



†U.S. Patent #4356393

- CR series MAXI-AMP modules work with the SP100 series of sub-miniature remote sensors (except SP100AF)
- All models may be powered directly by ac line voltage or by 12 to 28V dc
- Stand-alone design combines power supply, photoelectric amplifier, programmable timing logic (CR5 models), and output relay in a single, compact plug-in module
- All models include Banner's exclusive† AID™ (Alignment Indicating Device) signal strength indicating system for sensor alignment and monitoring
- Output response time is programmable for 10, 2, or 0.3 milliseconds
- Choose models with a 5-amp SPDT electromechanical output relay, or with a SPST solid-state ac/dc relay
- Choice of models with straight on/off sensing response (CR3 models) or with programmable 12-function timing logic (CR5 models)

MAXI-AMP CR Series Amplifier Modules

Models	Supply Voltage	Output Type	Sensor Compatibility	Output Timing Logic
CR3A	105-130V ac or 12-28V dc	SPST solid-state contact for switching ac loads up to 250V ac at up to 0.75A, or up to 30V dc at up to 50 mA plus SPST NPN transistor solid-state dc output	SP100 Series (except SP100AF) See pp. 541, 543 and 544	ON/OFF (no timing)
CR3B	210-250V ac or 12-28V dc			
CR5A	105-130V ac or 12-28V dc	SPST solid-state contact for switching ac loads up to 250V ac at up to 0.75A, or up to 30V dc at up to 50 mA		12 selectable timing functions (see pages 579 and 580)
CR5B	210-250V ac or 12-28V dc			
CR3RA	105-130V ac or 12-28V dc	SPDT electromechanical relay, plus SPST NPN transistor solid-state dc output		ON/OFF (no timing)
CR3RB	210-250V ac or 12-28V dc			
CR5RA	105-130V ac or 12-28V dc	SPDT electromechanical relay		12 selectable timing functions (see pages 579 and 580)
CR5RB	210-250V ac or 12-28V dc			

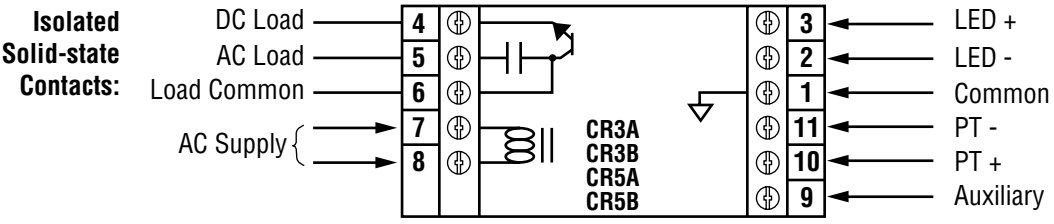
MAXI-AMP CR Series Amplifier Specifications

Sensor Compatibility	MAXI-AMP CR Series amplifier models are compatible with the following remote sensors: - SP100E and SP100R (see pp. 541, 543 and 544) - SP100D - SP100DB - SP100C - SP100CCF
Supply Voltage and Current	Models **CR3RA, CR3A, CR5RA** and **CR5A**: 105 to 130V ac (4 VA) or 12 to 28V dc at 70 mA max. Models **CR3RB, CR3B, CR5RB** and **CR5B**: 210 to 250V ac (4 VA) or 12 to 28V dc at 70 mA max.
Output Configuration	Models **CR3RA, CR3RB, CR5RA** and **CR5RB**: SPDT electromechanical relay Models **CR3A, CR3B, CR5A** and **CR5B**: SPST solid-state relay for switching ac or dc
Output Rating	Models **CR3RA, CR3RB, CR5RA** and **CR5RB** (with e/m relay): Max. switching voltage (resistive load) = 250V ac or 24V dc Max. switching current (resistive load) = 5A Min. voltage and current = 12V dc, 0.1A Mechanical life of relay = 20,000,000 operations Contact response time = 10 milliseconds max. open/close; 20 operations/sec. max. Models **CR3A, CR3B, CR5A** and **CR5B** (with solid-state output): Max. voltage and current = 250V ac, 0.75A or 30V dc, 50 mA **CR3** models also have a logic-level current sinking (NPN) transistor output at pin #9; maximum load is 20 mA at 12V dc
Output Response Time	Programmable for 10, 2, or 0.3 milliseconds on and off; add contact response (see above) for electromechanical output relay models, plus any applicable timing logic delay (CR5 models)
Adjustments	**All models**: GAIN (Sensitivity) adjustment is a multi-turn, clutched potentiometer; adjust with small flat-blade screwdriver **All models**: A 4-position DIP switch selects amplifier response, sensing hysteresis (Normal = 20% or Low = 5%), and light/dark operate **CR5 models:** A 10-position DIP switch selects output timing function: ON/OFF (no delay), ON delay, OFF delay, ON/OFF delay, One-shot (pulse), Delayed one-shot, Limit, Repeat cycle, AC latch, DC latch, Delay and latch, and Limit and latch; and timing ranges of 0.01 to 0.15 seconds, 0.1 to 1.5 seconds, or 1 to 15 seconds. See logic descriptions on pages 579 and 580. Timing adjustment is made using two multi-turn, clutched potentiometers; adjust with small flat-blade screwdriver
Indicators	Signal (red) AID™ System LED lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the received light signal LOAD (red) LED lights whenever the output relay is energized
Construction	NORYL® housing; standard round-pin, 11-pole plug base (use accessory wiring socket model RS-11, see page 593)
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Limit sensor cable length to 4.5 m (15'). Contact factory applications group if longer cable lengths are required. Up to three sensors (or emitter/receiver paris) may be connected together to one CR series amplifier for "OR" operation (light operate) or "NAND" operation (dark operate). Emitters are connected in series, and receivers are connected in parallel. When wiring two sensors to one MAXI-AMP, multiply excess gain data for each sensor by 1/2 (obtain data from applicable excess gain curve). When wiring three sensors to one MAXI-AMP, multiply excess gain by 1/3. Install transient suppressor (MOV) across contacts which switch inductive loads.
Certifications	

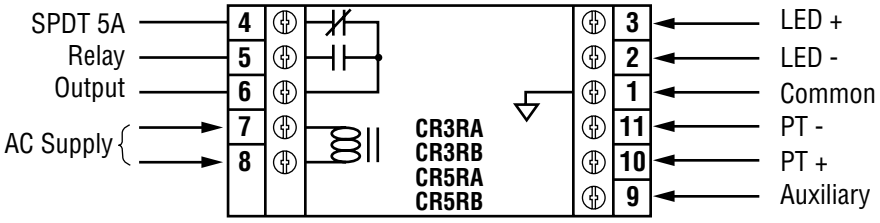
NORYL® is a registered trademark of General Electric Co.

MAXI-AMP CR Series Amplifier Hookup to Remote Sensors Diagrams

CR Series with Solid-State Output

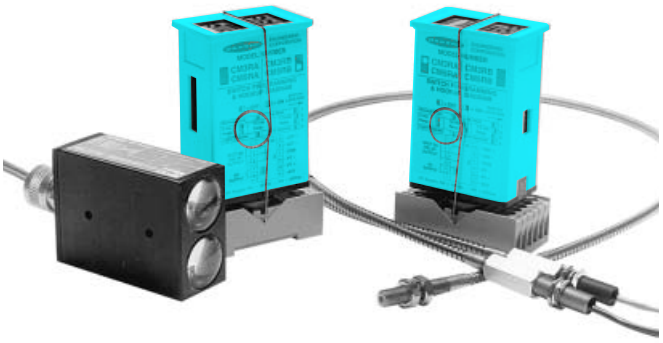


CR Series with Electromechanical Relay



NOTES:

MAXI-AMP CM Series Amplifier Modules



*U.S. Patent #4356393

- CM series models are higher-gain amplifiers which are used with Banner's complement of high-performance modulated remote sensors
- All models may be powered directly by ac line voltage or by 12 to 28V dc
- Stand-alone design combines power supply, photoelectric amplifier, programmable timing logic (CM5 models), and output relay in a single, compact plug-in module
- All models include Banner's exclusive† AID™ (Alignment Indicating Device) signal strength indicating system for sensor alignment and monitoring
- Output response time is programmable for 10, 2, or 0.3 milliseconds
- Choose models with a 5-amp SPDT electromechanical output relay, or with a SPST solid-state ac/dc relay
- Choice of models with straight on/off sensing response (CM3 models) or with programmable 12-function timing logic (CM5 models)

MAXI-AMP CM Series Amplifier Modules

Models	Supply Voltage	Output Type	Sensor Compatibility	Output Timing Logic
CM3A	105-130V ac or 12-28V dc	SPST solid-state contact for switching ac loads up to 250V ac at up to 0.75A, or up to 30V dc at up to 50 mA plus SPST NPN transistor solid-state dc output	LR Series PT Series SP300EL/RL SP300L SP320D LP400WB SP1000V See pp. 541-545	ON/OFF (no timing)
CM3B	210-250V ac or 12-28V dc			
CM5A	105-130V ac or 12-28V dc	SPST solid-state contact for switching ac loads up to 250V ac at up to 0.75A, or up to 30V dc at up to 50 mA		12 selectable timing functions (see pages 579 and 580)
CM5B	210-250V ac or 12-28V dc			
CM3RA	105-130V ac or 12-28V dc	SPDT electromechanical relay, plus SPST NPN transistor solid-state dc output		ON/OFF (no timing)
CM3RB	210-250V ac or 12-28V dc			
CM5RA	105-130V ac or 12-28V dc	SPDT electromechanical relay		12 selectable timing functions (see pages 579 and 580)
CM5RB	210-250V ac or 12-28V dc			

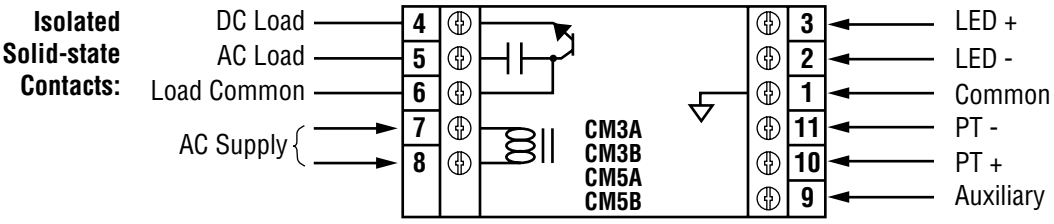
MAXI-AMP CM Series Amplifier Specifications

Sensor Compatibility	MAXI-AMP CM Series amplifier models are compatible with the following remote sensors: - LR200 and PT200 - LR250 and PT250 - LR300 and PT300 - LR400 and PT400 -SP300EL and SP300RL - SP300L - SP300D - SP320D - LP400WB - SP1000V (see pp. 541-545)
Supply Voltage and Current	Models **CM3RA, CM3A, CM5RA** and **CM5A**: 105 to 130V ac (4 VA) or 12 to 28V dc at 70 mA max. Models **CM3RB, CM3B, CM5RB** and **CM5B**: 210 to 250V ac (4 VA) or 12 to 28V dc at 70 mA max.
Output Configuration	Models **CM3RA, CM3RB, CM5RA** and **CM5RB**: SPDT electromechanical relay Models **CM3A, CM3B, CM5A** and **CM5B**: SPST solid-state relay for switching ac or dc
Output Rating	Models **CM3RA, CM3RB, CM5RA** and **CM5RB** (with e/m relay): Max. switching voltage (resistive load) = 250V ac or 24V dc Max. switching current (resistive load) = 5A Min. voltage and current = 12V dc, 0.1A Mechanical life of relay = 20,000,000 operations Contact response time = 10 milliseconds max. open/close; 20 operations/sec. max. Models **CM3A, CM3B, CM5A** and **CM5B** (with solid-state output): Max. voltage and current = 250V ac, 0.75A or 30V dc, 50 mA **CM3** models also have a logic-level current sinking (NPN) transistor output at pin #9; maximum load is 20 mA at 12V dc
Output Response Time	Programmable for 10, 2, or 0.3 milliseconds on and off; add contact response (see above) for electromechanical output relay models, plus any applicable timing logic delay (CM5 models)
Adjustments	**All models**: GAIN (Sensitivity) adjustment is a multi-turn, clutched potentiometer; adjust with small flat-blade screwdriver **All models**: A 4-position DIP switch selects amplifier response, sensing hysteresis (Normal = 20% or Low = 5%), and light/dark operate **CM5 models:** A 10-position DIP switch selects output timing function: ON/OFF (no delay), ON delay, OFF delay, ON/OFF delay, One-shot (pulse), Delayed one-shot, Limit, Repeat cycle, AC latch, DC latch, Delay and latch, and Limit and latch; and timing ranges of 0.01 to 0.15 seconds, 0.1 to 1.5 seconds, or 1 to 15 seconds. See logic descriptions on pages 579 and 580. Timing adjustment is made using two multi-turn, clutched potentiometers; adjust with small flat-blade screwdriver
Indicators	Signal (red) AID™ System LED lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the received light signal LOAD (red) LED lights whenever the output relay is energized
Construction	NORYL® housing; standard round-pin, 11-pole plug base (use accessory wiring socket model RS-11, see page 593)
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Limit sensor cable length to 15 m (50'). Contact factory applications group if longer cable lengths are required. When splicing extension cable, always use separate two-wire shielded cables for LED and PT connections. Up to three sensors (or emitter/receiver paris) may be connected together to one CM series amplifier for "OR" operation (light operate) or "NAND" operation (dark operate). Emitters are connected in series, and receivers are connected in parallel. When wiring two sensors to one MAXI-AMP, multiply excess gain data for each sensor by 1/2 (obtain data from applicable excess gain curve). When wiring three sensors to one MAXI-AMP, multiply excess gain by 1/3. Install transient suppressor (MOV) across contacts which switch inductive loads.
Certifications	

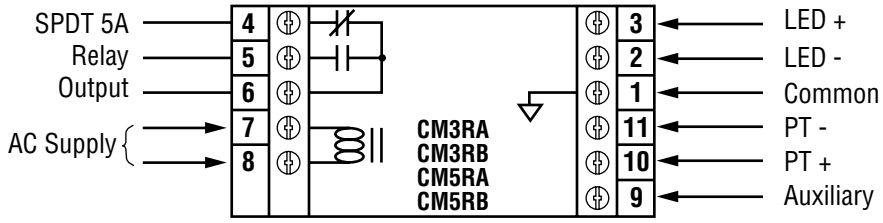
NORYL® is a registered trademark of General Electric Co.

MAXI-AMP CM Series Amplifier Hookup to Remote Sensors Diagrams

CM Series with Solid-State Output

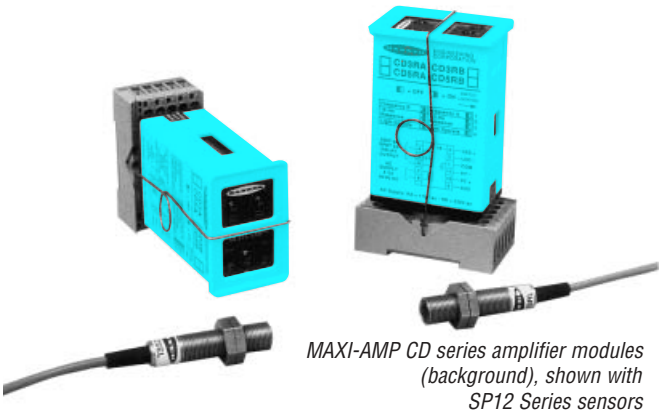


CM Series with Electromechanical Relay



NOTES:

MAXI-AMP CD Series Amplifier Modules



MAXI-AMP CD series amplifier modules (background), shown with SP12 Series sensors

*U.S. Patent #4356393

- The CD series is specially-designed for use with the powerful SP12 opposed mode sensors which are designed for difficult sensing environments
- All models may be powered directly by ac line voltage *or* by 12 to 28V dc
- Stand-alone design combines power supply, photoelectric amplifier, programmable timing logic (CD5 models), and output relay in a single, compact plug-in module
- All models include Banner's exclusive† AID™ (Alignment Indicating Device) signal strength indicating system for sensor alignment and monitoring
- Output response time is programmable for 15 or 1.5 milliseconds
- Choose models with a 5-amp SPDT electromechanical output relay, or with a SPST solid-state ac/dc relay
- Choice of models with straight on/off sensing response (CD3 models) or with programmable 12-function timing logic (CD5 models)

MAXI-AMP CD Series Amplifier Modules

Models	Supply Voltage	Output Type	Sensor Compatibility	Output Timing Logic
CD3A	105-130V ac or 12-28V dc	SPST solid-state contact for switching ac loads up to 250V ac at up to 0.75A, or up to 30V dc at up to 50 mA plus SPST NPN transistor solid-state dc output	SP12SEL & SP12SRL SP12PEL & SP12PRL See p. 542	ON/OFF (no timing)
CD3B	210-250V ac or 12-28V dc			
CD5A	105-130V ac or 12-28V dc	SPST solid-state contact for switching ac loads up to 250V ac at up to 0.75A, or up to 30V dc at up to 50 mA		12 selectable timing functions (see pages 579 and 580)
CD5B	210-250V ac or 12-28V dc			
CD3RA	105-130V ac or 12-28V dc	SPDT electromechanical relay, plus SPST NPN transistor solid-state dc output		ON/OFF (no timing)
CD3RB	210-250V ac or 12-28V dc			
CD5RA	105-130V ac or 12-28V dc	SPDT electromechanical relay		12 selectable timing functions (see pages 579 and 580)
CD5RB	210-250V ac or 12-28V dc			

MAXI-AMP CD Series Amplifier Specifications

Sensor Compatibility	MAXI-AMP CD Series amplifier models are compatible with the following remote sensors: - SP12SEL and SP12SRL - SP12PEL and SP12PRL
Supply Voltage and Current	Models **CD3RA, CD3A, CD5RA** and **CD5A**: 105 to 130V ac (4 VA) or 12 to 28V dc at 70 mA max. Models **CD3RB, CD3B, CD5RB** and **CD5B**: 210 to 250V ac (4 VA) or 12 to 28V dc at 70 mA max.
Output Configuration	Models **CD3RA, CD3RB, CD5RA** and **CD5RB**: SPDT electromechanical relay Models **CD3A, CD3B, CD5A** and **CD5B**: SPST solid-state relay for switching ac or dc
Output Rating	Models **CD3RA, CD3RB, CD5RA** and **CD5RB** (with e/m relay): Max. switching voltage (resistive load) = 250V ac or 24V dc Max. switching current (resistive load) = 5A Min. voltage and current = 12V dc, 0.1A Mechanical life of relay = 20,000,000 operations Contact response time = 10 milliseconds max. open/close; 20 operations/sec. max. Models **CD3A, CD3B, CD5A** and **CD5B** (with solid-state output): Max. voltage and current = 250V ac, 0.75A or 30V dc, 50 mA **CD3** models also have a logic-level current sinking (NPN) transistor output at pin #9; maximum load is 20 mA at 12V dc
Output Response Time	Programmable for 1.5 or 15 milliseconds ON and OFF; add contact response (see above) for electromechanical output relay models, plus any applicable timing logic delay (CD5 models)
Adjustments	**All models**: GAIN (Sensitivity) adjustment is a multi-turn, clutched potentiometer; adjust with small flat-blade screwdriver **All models**: A 4-position DIP switch selects amplifier response, modulating frequency "A" or "B" (to minimize adjacent emitter/receiver pair optical crosstalk), and light or dark operate **CD5 models:** A 10-position DIP switch selects output timing function: ON/OFF (no delay), ON delay, OFF-delay, ON/OFF delay, One-shot (pulse), Delayed one-shot, Limit, Repeat cycle, AC latch, DC latch, Delay and latch, and Limit and latch; and timing ranges of 0.01 to 0.15 seconds, 0.1 to 1.5 seconds, or 1 to 15 seconds. See logic descriptions on pages 579 and 580. Timing adjustment is made using two multi-turn, clutched potentiometers; adjust with small flat-blade screwdriver
Indicators	Signal (red) AID™ System LED lights whenever the sensor sees its modulated light source, and pulses at a rate proportional to the received light signal LOAD (red) LED lights whenever the output relay is energized
Construction	NORYL® housing; standard round-pin, 11-pole plug base (use accessory wiring socket model RS-11, see page 593)
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Limit sensor cable length to 30 m (100'). Contact factory applications group if longer cable lengths are required. When splicing extension cable, always use separate two-wire shielded cables for LED and PT connections (never combine emitter and receiver wires in one cable). One (only) SP12 emitter/receiver pair may be connected to a CD series amplifier module. Install transient suppressor (MOV) across contacts which switch inductive loads.
Certifications	

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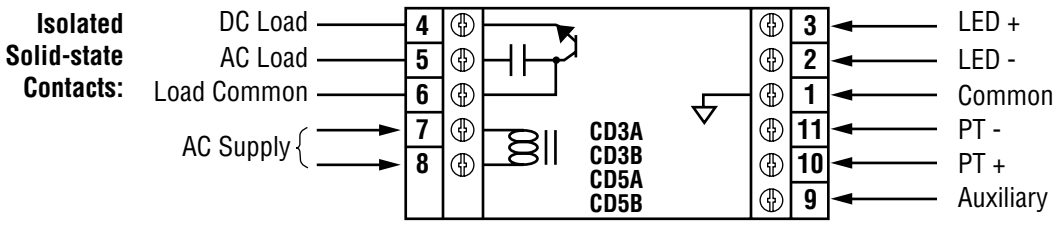
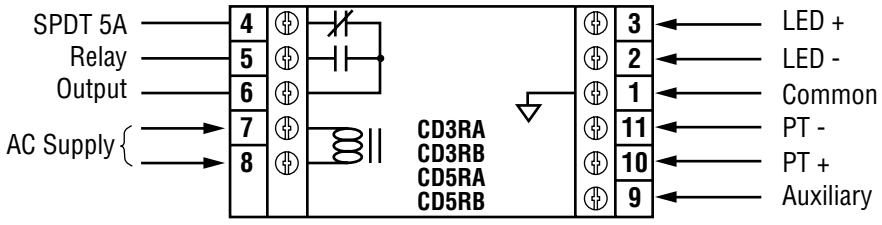
MAXI-AMP CD Series Amplifier Hookup to Remote Sensors Diagrams

CD Series with Solid-State Output

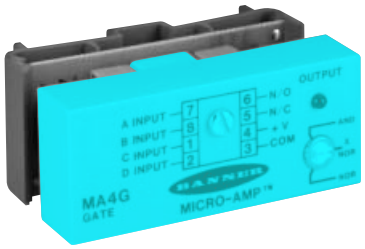


CD Series with Electromechanical Relay



NOTES:

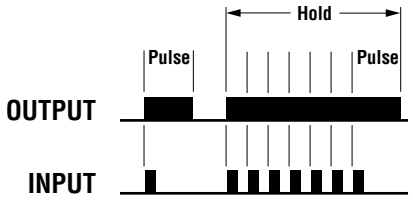
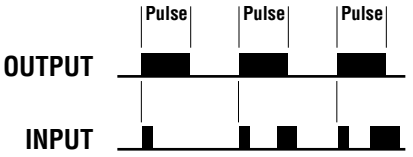
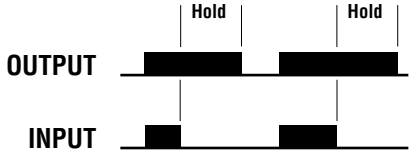
MICRO-AMP Logic Modules



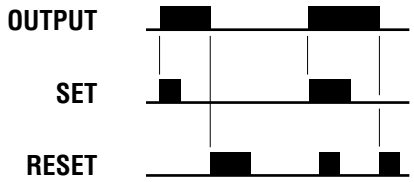
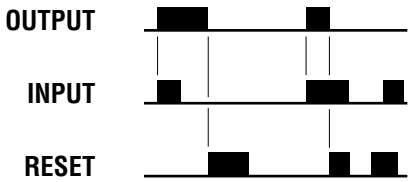
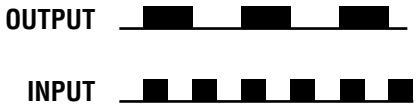
MICRO-AMP model MA4G shown

- MICRO-AMP logic modules are 10 to 30V dc devices used for add-on output timing control or for multiple-sensor logic functions
- Inputs respond to logic “low” signals of 1-millisecond duration or longer derived from switches or relay contacts, or from dc sensors or amplifiers with an NPN (current sinking) output
- Outputs are complementary (SPDT) open-collector NPN (current sinking) transistors
- Totally-encapsulated solid-state circuitry; gold-flashed connector pins
- May be mounted directly to a printed circuit board, or wired using an optional RS8 socket or MPS-15 power supply (see Accessories, pages 591 and 592)

MICRO-AMP Logic Modules

Models	Type	Logic Functions	Timing Ranges	Timing Diagrams
MA4-2	One-shot (Pulse)	Retriggerable One-shot	0.001 to 0.1 seconds 0.01 to 1.0 second 1.0 to 15 seconds	
		Non-retriggerable One-shot		
MA5	Delay	On-delay	0.01 to 1.0 second 1.0 to 15 seconds	
		Off-delay		
MA4G	4-input Gate	2, 3, or 4-input AND Gate	None	Normally-open output energizes when all inputs are: simultaneously low = AND function simultaneously high = NOR function simultaneously either low or high = x-NOR function

MICRO-AMP Logic Modules

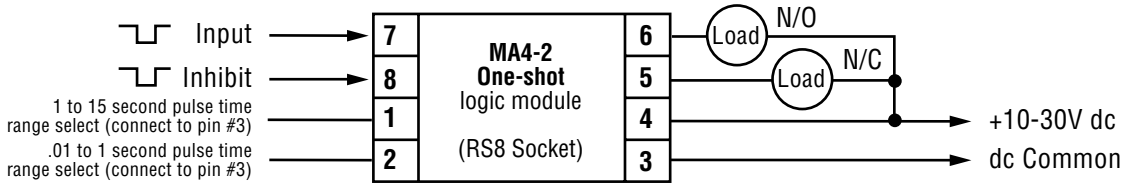
Models	Type	Logic Functions	Timing Ranges	Timing Diagrams
MA4L	Latch Logic	Set/reset Latch	None	
		Edge-triggered Latch		
		Flip-flop (Divide by 2)		

MICRO-AMP Logic Module Specifications

Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 20 mA (exclusive of load)
Inputs	Inputs respond to a logic "low" signal. A logic "low" must be less than 2V dc; a logic "high" is at least 6V dc, or an open circuit. Inputs must be capable of sinking at least 4 milliamps. Inputs may be derived from limit switches or relay contacts or from dc sensors or amplifiers with NPN (current sinking) output transistors. NOTE: models MA4L and MA5 may be programmed to respond to "high-going" signals.
Input Response Time	All inputs will respond to a signal of 1 millisecond duration or longer
Output Configuration	Two complementary (SPDT) open-collector NPN (current sinking) transistors
Output Rating	150 mA maximum, each output **Off-state leakage current** less than 1 microamp **Output saturation voltage** less than 0.5V dc at 10 milliamps
Adjustments	**Models MA4-2, MA5**: A single-turn potentiometer allows adjustment of pulse or delay timing within the selected time range (use small flat-bladed screwdriver) **Model MA4G**: A single-turn potentiometer selects the logic mode: Fully clockwise = NOR mode; fully counterclockwise = AND mode; midpoint = X-NOR (exclusive "NOR") mode **Model MA4L:** A single-turn potentiometer selects the input response polarity: Fully clockwise = high-going transition; fully counterclockwise = low-going transition
Indicators	Red LED indicator on the top of the module lights whenever the N/O output is conducting
Construction	Circuitry is totally epoxy-encapsulated in molded thermoplastic polyester housing; gold-flashed connection pins
Connections	Solder directly to printed circuit board, or use sockets RS8 or RS8K (see Accessories, page 591)
Operating Conditions	**Temperature:** 0° to +70°C (+32° to 158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)

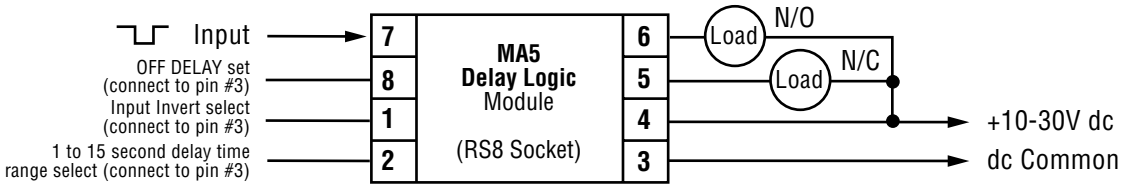
MICRO-AMP Logic Module Hookup Diagrams

MA4-2 One-Shot Module

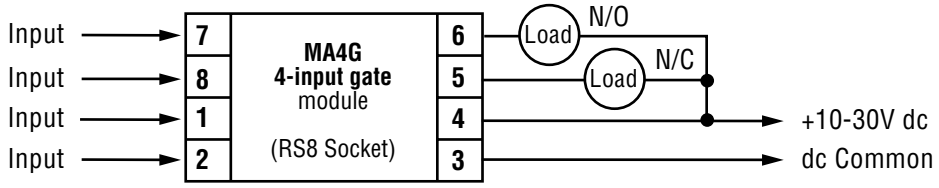


MICRO-AMP Logic Module Hookup Diagrams

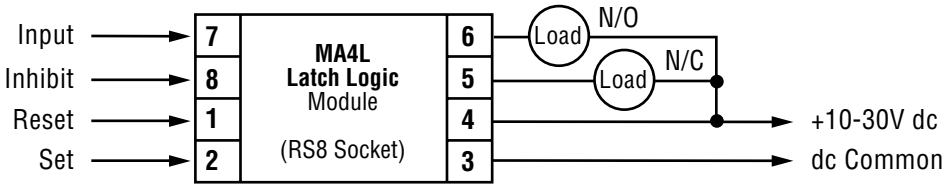
MA5 Delay Logic Module



MA4G 4-Input Gate Module



MA4L Latch Logic Module



MAXI-AMP CL Series Logic Modules

- CL series MAXI-AMP modules combine sensor power supply, output relay, and programmable timing logic (CL5 models) in a stand-alone, cost-saving package
- All models may be powered directly by ac line voltage or by 12 to 28V dc
- CL5 models offer 12 programmable popular timing functions (see pages 579 and 580) and choice of three timing ranges
- Compatible with any dc sensor or amplifier module with an NPN (sinking) output, switch or relay “hard” contacts or the output of an optical coupler (see specifications)
- Any number of switched output devices may be connected in parallel to the input for multiple-sensor logic
- Logic functions of CL5 models may be gated by connection of a dc sensor or switch contact to the “Auxiliary” input (see logic descriptions on pages 579 and 580)
- 1-millisecond input response
- Choose models with 5-amp SPDT electromechanical output relay, or with a SPST solid-state ac/dc relay

MAXI-AMP CL Series Logic Modules

Models	Compatible Inputs	Supply Voltage	Output Type	Output Timing Logic
CL3A	NPN (sinking) output of any dc sensor or amplifier, switch contacts, or optical couplers	105-130V ac or 12-28V dc	SPST solid-state contact for switching ac loads up to 250V ac at up to 0.75A, or up to 30V dc at up to 50 mA plus SPST NPN transistor solid-state dc output	ON/OFF (no timing)
CL3B		210-250V ac or 12-28V dc		
CL5A		105-130V ac or 12-28V dc	SPST solid-state contact for switching ac loads up to 250V ac at up to 0.75A, or up to 30V dc at up to 50 mA	12 selectable timing functions (see pages 579 and 580)
CL5B		210-250V ac or 12-28V dc		
CL3RA		105-130V ac or 12-28V dc	SPDT electromechanical relay, plus SPST NPN transistor solid-state dc output	ON/OFF (no timing)
CL3RB		210-250V ac or 12-28V dc		
CL5RA		105-130V ac or 12-28V dc	SPDT electromechanical relay	12 selectable timing functions (see pages 579 and 580)
CL5RB		210-250V ac or 12-28V dc		

MAXI-AMP CL Series Logic Module Specifications

Supply Voltage and Current	Models **CL3RA, CL3A, CL5RA** and **CL5A**: 105 to 130V ac (4 VA) or 12 to 28V dc at 70 mA max. Models **CL3RB, CL3B, CL5RB** and **CL5B**: 210 to 250V ac (4 VA) or 12 to 28V dc at 70 mA max.
Input Compatibility	MAXI-AMP CL series logic models are compatible with any dc sensor or amplifier module with an NPN (sinking) output; any switch (e.g. an electromechanical relay) contact, or the output of an optical coupler
Input Characteristics	Input is switched when the voltage at pin #2 is pulled below 1V dc, or when less than 1KΩ is connected between pins #1 and #2. When an inverting jumper is connected between pins #10 and #11, the input is switched when the voltage at pin #2 rises above 4.5V dc, or when the impedance between pins #2 and #1 exceeds 15KΩ.
Output Configuration	Models **CL3RA, CL3RB, CL5RA** and **CL5RB**: SPDT electromechanical relay Models **CL3A, CL3B, CL5A** and **CL5B**: SPST solid-state relay for switching ac or dc
Output Rating	Models **CL3RA, CL3RB, CL5RA** and **CL5RB** (with e/m relay): Max. switching voltage (resistive load) = 250V ac or 24V dc Max. switching current (resistive load) = 5A Min. voltage and current = 12V dc, 0.1A Mechanical life of relay = 20,000,000 operations Contact response time = 10 milliseconds max. open/close; 20 operations/sec. max. Models **CL3A, CL3B, CL5A** and **CL5B** (with solid-state output): Max. voltage and current = 250V ac, 0.75A or 30V dc, 50 mA **CL3** models also have a logic-level current sinking (NPN) transistor output at pin #9; maximum load is 20 mA at 12V dc
Output Response Time	1 millisecond on and off; add contact response (see above) for electromechanical output relay models, plus any applicable timing logic delay (CL5 models)
Current Available for Powering External dc Devices	50 mA max. at 120V ac (240V ac) line level 40 mA max. at 105 V ac (210V ac) line level
Adjustments	**CL5 models:** A 10-position DIP switch selects output timing function: On/Off (no delay), On delay, Off delay, On/Off delay, One-shot (pulse), Delayed one-shot, Limit, Repeat cycle, AC latch, DC latch, Delay and latch, and Limit and latch; and timing ranges of 0.01 to 0.15 seconds, 0.1 to 1.5 seconds, or 1 to 15 seconds. See logic descriptions on pages 579 and 580. Timing adjustment is made using two multi-turn, clutched potentiometers; adjust with small flat-blade screwdriver
Indicators	Signal (red) LED lights whenever input signal is present LOAD (red) LED lights whenever the output relay is energized
Construction	NORYL® housing; standard round-pin, 11-pole plug base (use accessory wiring socket model RS-11, see page 593)
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Any number of switched output devices may be connected in parallel to the input Install transient suppressor (MOV) across contacts which switch inductive loads
Certifications	

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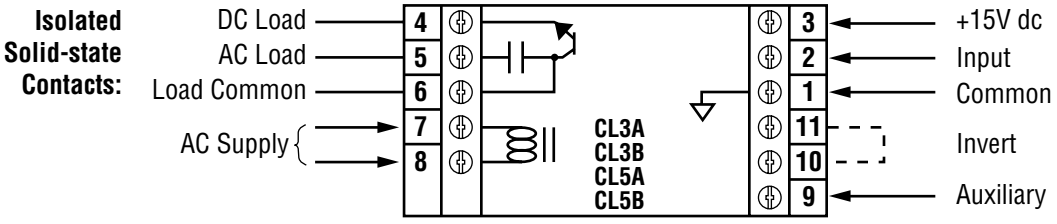
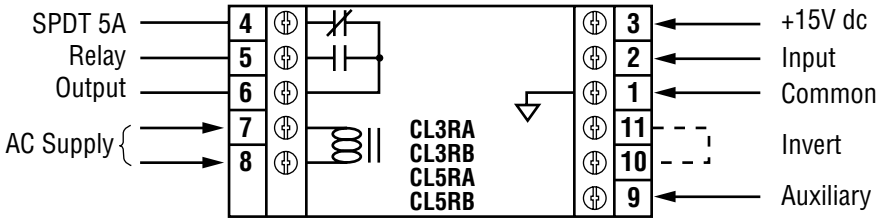
MAXI-AMP CL Series Logic Module Hookup Diagrams

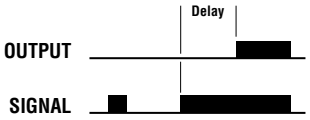
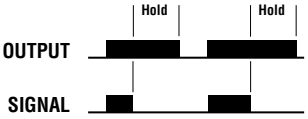
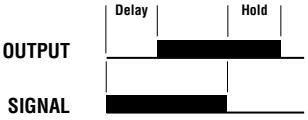
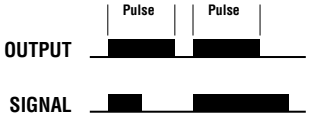
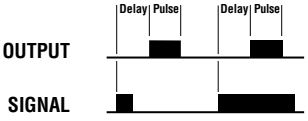
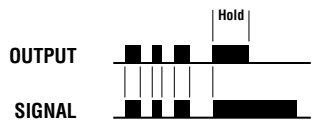
CL Logic Module with Solid-State Output



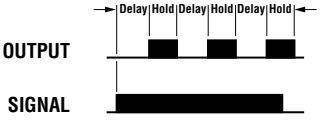
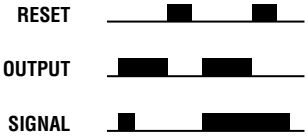
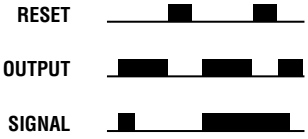
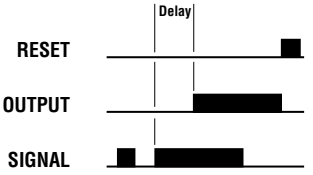
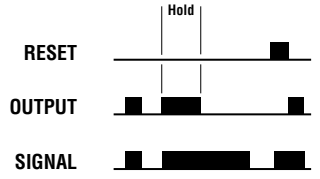
CL Logic Module with Electromechanical Relay



Timing Logic Functions for Models CD5, CL5, CM5 and CR5 Amplifier Modules

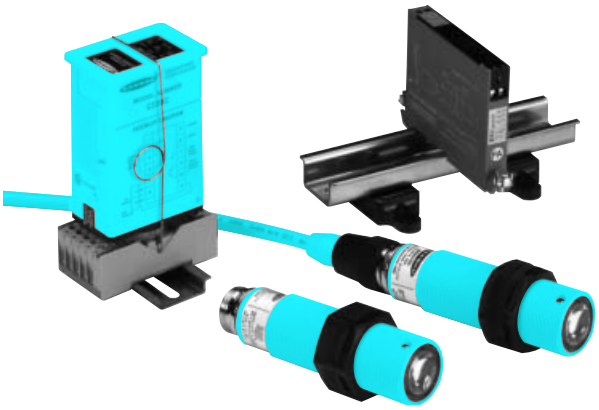
Timing Function	Description	Timing Diagram
On/Off	On/Off operation does not involve timing. The output simply follows the action of the input signal. Grounding pin #9 (AUXILIARY) turns the output "OFF", regardless of the state of the input signal. This may be accomplished by closing a switch or relay contact between pins #9 and #1 (common), or by connecting an open collector NPN (current sinking) output of any external dc device directly to pin #9. NOTE: connect the COMMON of any external dc device to pin #1 of the MAXI-AMP to establish a voltage reference between the dc supply for the external device and the internal dc supply of the MAXI-AMP.	
On Delay	The On Delay timer keeps the output "OFF" until the selected LIGHT or DARK signal has been present for the preset "Delay" time. If the input signal is interrupted, the timing is reset and starts over with the next signal. Grounding pin #9 immediately cancels an output in progress and resets the delay timer. The delay timer is restarted when the inhibit signal is removed, if an input signal is present.	
Off Delay	The output energizes immediately when the input signal occurs, but does not de-energize until the signal has been removed for the preset Off Delay ("HOLD") time. Grounding pin #9 prevents an output from occurring. If an inhibit input occurs during an output, the output remains "ON" for the remainder of the Off Delay time.	
On/Off Delay	On and Off Delay logic combines both timing functions into a single mode. The On Delay ("Delay") time and the Off Delay ("HOLD") time are independently adjustable within the selected time range. Momentary grounding of pin #9 during the On Delay period resets the Delay timer. An inhibit signal which occurs during an output will allow the output to stay energized for the remainder of the Off Delay time. On and Off Delay logic is often used in jam and void control, high/low level control, and edge-guiding applications.	
One-shot	The output of a One-shot function is a pulse of adjustable duration which is independent of the duration of the input signal. With the MAXI-AMP programmed for LIGHT operate, the pulse occurs when the input signal changes from dark to light. In DARK operate, the pulse occurs with a light to dark input transition. Grounding pin #9 prevents the one-shot from triggering, but does not affect a pulse already under way.	
Delayed One-shot	Delayed One-shot: A Delayed One-shot is initiated by either a momentary or maintained input signal. This input starts the adjustable "Delay" period, after which the output pulses for an adjustable time. No further action occurs unless the input is removed and reapplied, beginning a new sequence. Grounding pin #9 during the delay period will cancel the sequence, and no output occurs. This feature is often used for inspection/rejection control logic. An inhibit signal will not affect a pulse under way.	
Limit	The output of the Limit function follows the action of the input, as it does with the ON/OFF function. However, an input signal which is longer than the adjustable Limit ("HOLD") time will turn the output "OFF". Removing the input signal resets the timer. This function is sometimes called. "Time Limited ON/OFF", and is useful for energy conservation. Grounding pin #9 cancels the output. Lifting the inhibit restarts the Limit timer, if an input signal is present.	

Timing Logic Functions for Models CD5, CL5, CM5 and CR5 Amplifier Modules

Timing Function	Description	Timing Diagram
Repeat Cycle	The Repeat Cycle function provides an oscillating output when an input signal is present. Presence of an input signal triggers an adjustable “Delay” timer. After the delay, the output energizes for an adjustable “HOLD” period. If the input remains, the output continues to cycle “ON” and “OFF” at this rate indefinitely. When the signal is removed, any output in progress completes and then remains “OFF” until the next signal and Delay period. Grounding pin #9 cancels the sequence, but will allow the completion of a “HOLD” period in progress. Lifting the inhibit signal begins the Delay period, if an input signal is present.	
AC Latch	An AC Latch is the combination of a One-shot and a Latch. A momentary or sustained input will latch the output “ON”. Grounding pin #9 will reset the latch, even if the input signal remains. The output will not re-latch until the input signal is removed and then reapplied.	
DC Latch	The output will latch “ON” whenever the selected LIGHT or DARK input condition occurs. Grounding pin #9 of a dc latch will turn the output "OFF" regardless of the state of the input signal. If the signal is present when the reset is removed, the output will immediately latch “on” again.	
Delay and Latch	The Delay and Latch is a combination of the On-Delay and DC Latch functions. An input must be present for at least the adjustable “Delay” time for the output to latch “ON”. If the input signal is removed during the timing cycle, the timing is reset. Momentary grounding of pin #9 resets the latch and/or the Delay timing cycle. Sustained grounding of pin #9 inhibits any output.	
Limit and Latch	The Limit and Latch operates exactly like the Limit function, except that the Limit (“HOLD”) timer can be reset only by the auxiliary input. An output remains latched “OFF” until reset by momentarily grounding pin #9. In addition to resetting the timer, grounding pin #9 will hold the output "OFF", regardless of the state of the input signal.	

NOTES:

CI3RC2 Current Trip Point Amplifier



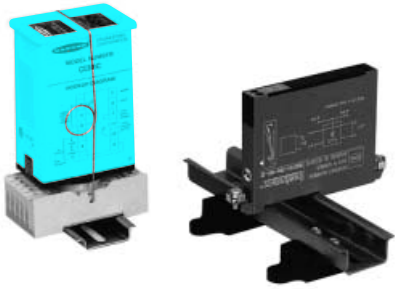
- Current trip point amplifier for use with Banner SMI series intrinsically safe dc sensors
- Works with an intrinsically safe barrier to convert the current output signal from an SMI30 series opposed mode receiver or from any SMI912 VALU-BEAM® sensor to a trip point switch
- Powered by 105 to 130V ac or 210 to 250V ac
- Powers a single intrinsically safe sensor or both the emitter and receiver of an opposed mode pair
- Offers two output devices: SPDT 5 amp electromechanical relay and an opto-isolated transistor for logic level dc switching
- Wires using accessory 11-pin socket model RS-11 (see page 593)
- Also available as part of an intrinsic safety kit which includes the intrinsic safety barrier(s) and mounting hardware

Current Trip Point Amplifier

Models	Supply Voltage	Input Requirements	Sensor Compatibility	Output Type
CI3RC2	105-130V ac or 210-250V ac	≤10 milliamps “Off” ≥20 milliamps “On”	SMI912 series (p. 356) SMI30 series (p. 290)	SPDT Electromechanical relay and SPST solid-state dc relay

Intrinsic Safety Kits

Model	Description
CI2BK-1	Kit includes a CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount, and one single-channel intrinsically safe barrier (barriers also sold separately - see below)
CI2BK-2	Typically used in Opposed Mode setups, this kit includes a CI3RC2 current amplifier, one RS-11 socket, one DIN-rail mount, and dual-channel intrinsically safe barrier (barriers also sold separately - see below)
CIB-1	Single-channel barrier
CI2B-1	Dual-channel barrier



CI3RC2 Current Trip Point Amplifier Specifications

Sensor Compatibility	SMI30 series sensors (see page 290) SMI912 series sensors (see page 356)
Supply Voltage and Current	105 to 130V ac or 210 to 250V ac (8 VA)
Input Requirements	Trip point for output "off": ≤10 milliamps Trip point for output "on": ≥20 milliamps Trip point range for input overload indication: 30 mA ≤1 ≤80 mA
Output Configuration	SPDT electromechanical relay, plus SPST optically-coupled solid-state relay for switching dc
Output Rating	Electromechanical relay: Max. switching voltage (resistive load) = 250V ac or 24V dc Max. switching current (resistive load) = 5A Min. voltage and current = 12V dc, 0.1A Mechanical life of relay = 20,000,000 operations Contact response time = 10 milliseconds max. open/close; 20 operations/sec. max. Solid-state dc output: Max. voltage and current = 30V dc, 20 mA
Indicators	OUTPUT (red) LED lights whenever electromechanical relay and solid state relay are energized INPUT (red) LED lights whenever input is overloaded or short circuited
Construction	NORYL® housing; standard round-pin, 11-pole plug base (use accessory wiring socket model RS-11, see page 593)
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	This amplifier must be used with appropriate intrinsic safety barriers for the sensing system to be certified as intrinsically safe. See the hookup diagrams for the sensors to be used. Install transient suppressor (MOV) across contacts which switch inductive loads
Certifications	

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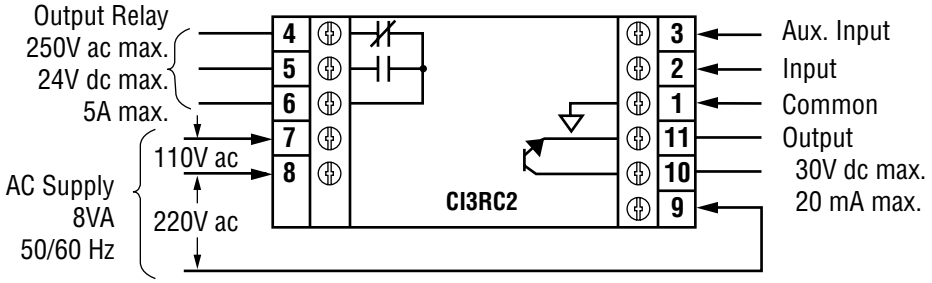
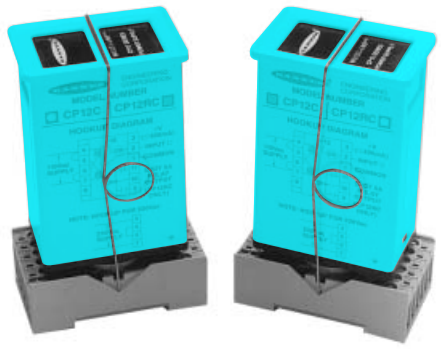
CI3RC2 Current Trip Point Amplifier Hookup Diagram



MAXI-AMP CP Series Power Supply Modules

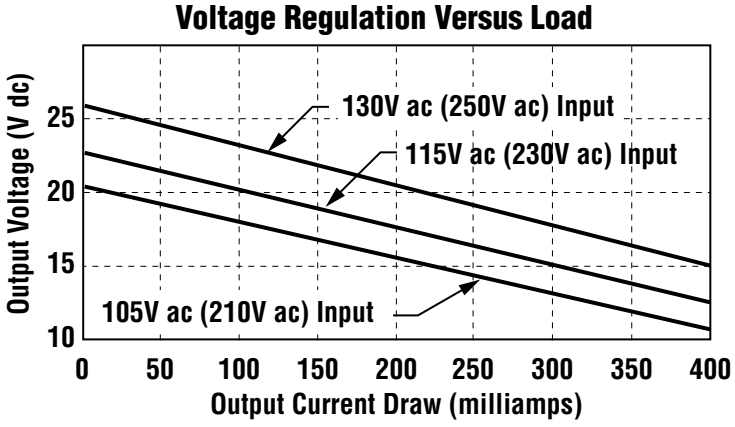


- CP series power supply modules provide a convenient source of power for Banner dc sensing devices; supply capacity to 400 milliamps
- Designed to accept either 120 or 220/240V ac input voltage (see hookup diagrams)
- Model CP12RC includes SPDT 5-amp rated electro-mechanical relay which may be switched by the output of dc sensors or modules
- Wires using standard round-pin 11-pole relay socket (use model RS-11, see Accessories, page 593)

CP Series Power Supply Modules

Models	Supply Voltage	Output Power	Output Switch
CP12C	105-130V ac or 210-250V ac	400 milliamps maximum for 10-30V dc sensing devices	None
CP12RC			SPDT 5A E/m relay

MAXI-AMP CP Series Load Curve



MAXI-AMP CP Series Specifications

Supply Voltage and Current	105 to 130V ac or 210 to 250V ac, depending on wiring (see hookup diagrams)
Output Voltage	See load curve
Output Current	400 milliamps, maximum
Output Configuration	Model **CP12RC** (only): SPDT electromechanical relay The relay is energized by an NPN (sinking) device connected at pin #2, or PNP (sourcing) device at pin #8 (see hookup diagrams)
Output Rating	Model **CP12RC** (only): Max. switching voltage (resistive load) = 250V ac or 24V dc Max. switching current (resistive load) = 5A Min. voltage and current = 12V dc, 0.1A Mechanical life of relay = 20,000,000 operations Contact response time = 10 milliseconds max. open/close; 20 operations/sec. max.
Construction	NORYL® housing; standard round-pin, 11-pole plug base (use accessory wiring socket model RS-11, see page 593)
Operating Conditions	**Temperature:** 0° to +50°C (+32° to 122°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Notes	Install transient suppressor (MOV) across contacts which switch inductive loads
Certifications	

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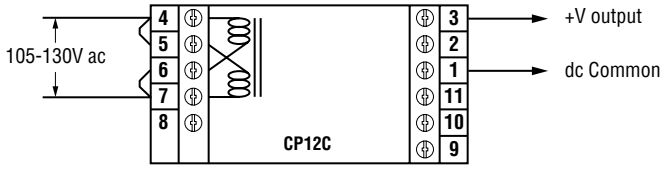
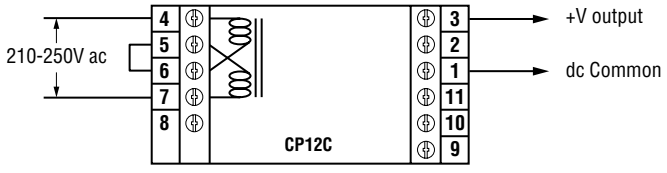
MAXI-AMP CP Series Hookup Diagrams

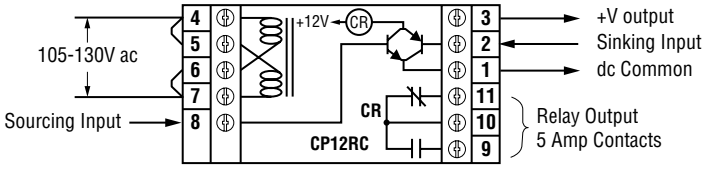
CP12C-120V



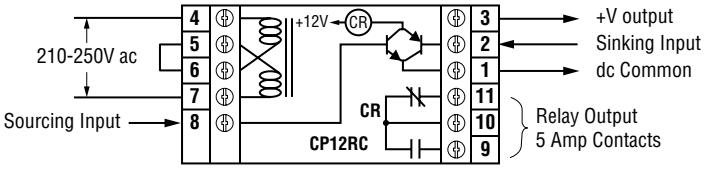
CP12C-220V



CP12RC-120V

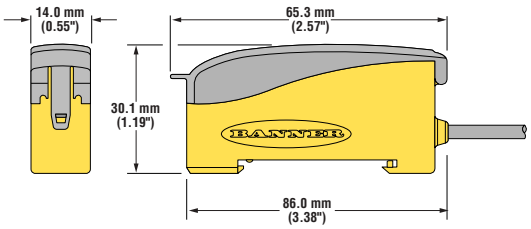


CP12RC-220V

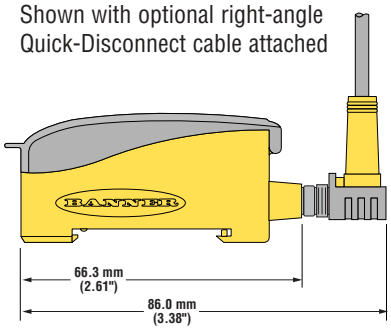


Dimensions

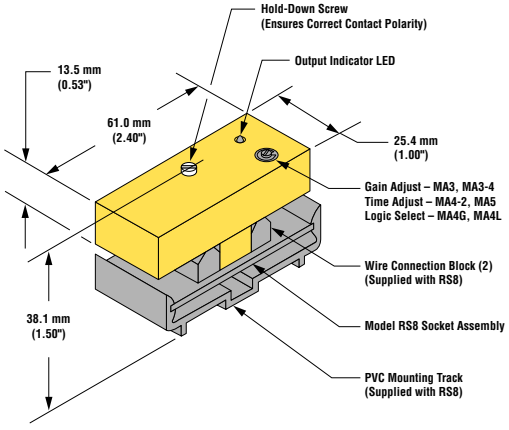
Dimensions for PICO-AMP MD14 Series Amplifier Modules

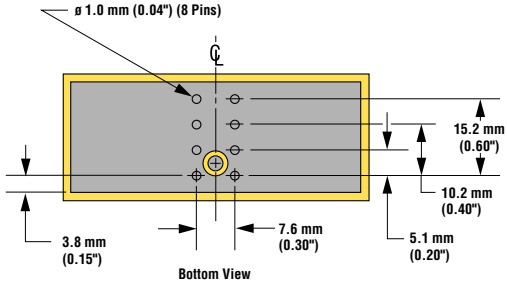


Shown with optional right-angle Quick-Disconnect cable attached

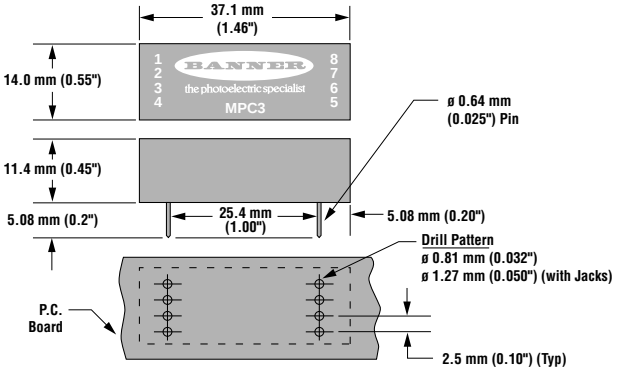


Dimensions for MICRO-AMP Amplifier Modules MA3, MA3P, MA3-4, MA3-4P and MA3AF Series and MICRO-AMP Logic Modules

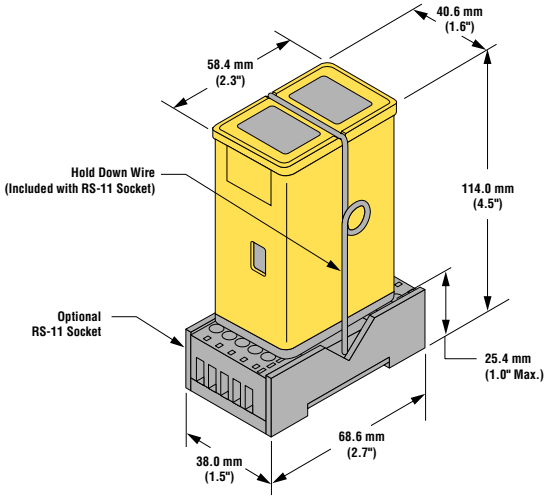




Dimensions for MICRO-AMP Amplifier Module MPC3 Series



Dimensions for MAXI-AMP Amplifier Modules CR, CM and CD Series, MAXI-AMP CL Logic Modules, MAXI-AMP CI3RC2 Current Trip Point Amplifier, and MAXI-AMP Power Supply Modules



Extension Cables

Modulated remote sensors require specially designed cable for efficient sensor performance. Extension cable is available in 30 m (100') lengths.

Model	# of Wires	Wire Colors	Used with:
ESC-100	3	White, Green, Shield	LR200, LR250, LR400 and SP300EL
RSC-100	3	Red, Black, Shield	PT200, PT250, PT400 and SP300RL
SSC-100	5	White, Green, Red, Black, Shield	SP300D, SP300L, LP400WB and SP1000V
EC300E-100	2	White, Shield	LR300
EC300R-100	2	Red, Shield	PT300
EC320-100	4	White, Shield, Red, Shield	SP320D

Compression Fittings

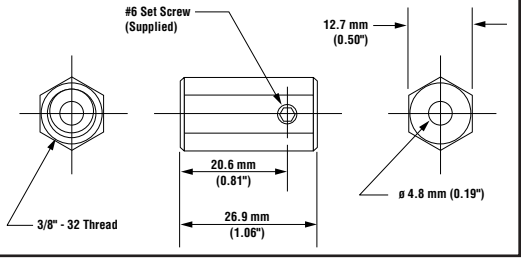
Used to attach protective tubing to remote sensors

Model	Thread Size	Used with:	Description
CF3-8	3/8" - 32	LR400, PT400 and LP400WB	
CF7-16	7/16" - 20	SP300EL, SP300RL, SP300D, SP300L, LR200 and PT200	

Cable Protection

Model	Description	Cable Length	Dimensions
AC-6	This is mild-steel flexible tubing used with the compression fittings (see above), to achieve maximum protection to sensor cables.	1.8 m (6')	I.D. = 7.9 mm (0.31") O.D. = 11.2 mm (0.44")
AC-30		9 m (30')	
PVC-6	Heavy duty PVC tubing used to protect sensor cable in applications involving moisture and/or corrosive materials.	1.8 m (6')	I.D. = 6.4 mm (0.25") O.D. = 9.7 mm (0.38")
PVC-30		9 m (30')	

Fiber Optic Fitting

Model	Description	
FOF400	• These fiber optic fittings permit the connection of LR400 and PT400 remote sensors to a glass fiber optic assembly • The sensors are typically mounted through 10 mm (3/8") diameter clearance holes, with the FOF-400 fittings threaded onto them after mounting	

Quick-Disconnect (QD) Cables

Style	Model	Length	Connector	For use with
4-Pin Pico	**PKG4-2** **PKW4-2**	2 m (6.5') 2 m (6.5')	Straight Right-Angle	PICO-AMP amplifiers
4-Pin Euro	**MQDC-406** **MQDC-415** **MQDC-430**	2 m (6.5') 5 m (15') 9 m (30')	Straight	SP12 Series sensors
	MQDC-406RA **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30')	Right-Angle	

AP400 Apertures

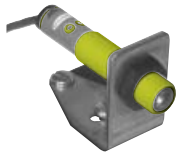
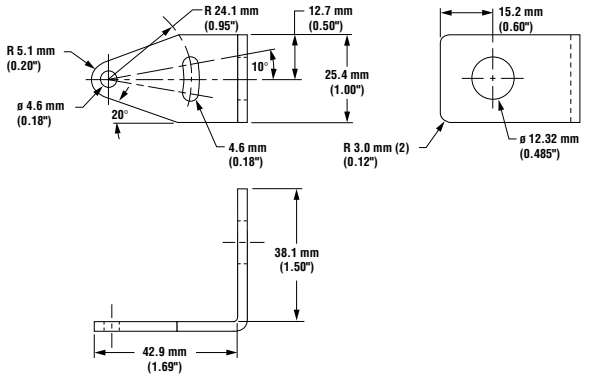
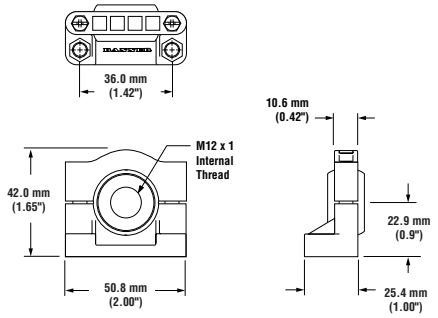
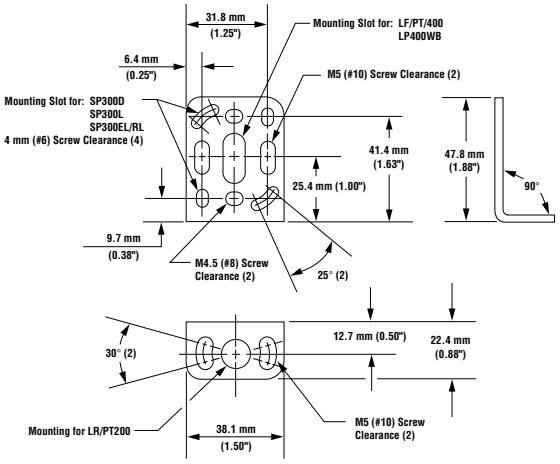
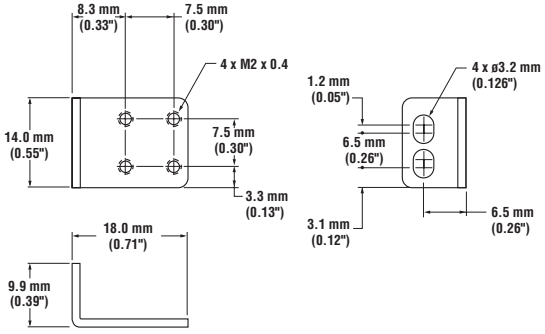
Model	Description	
AP400-010 **AP400-015** **AP400-040** **AP400-030R**	0.25 mm (0.01") diameter 0.38 mm (0.015") diameter 1.0 mm (0.04") diameter 0.76 mm x 3.2 mm (0.030 x 0.125")	

Aperture Kits

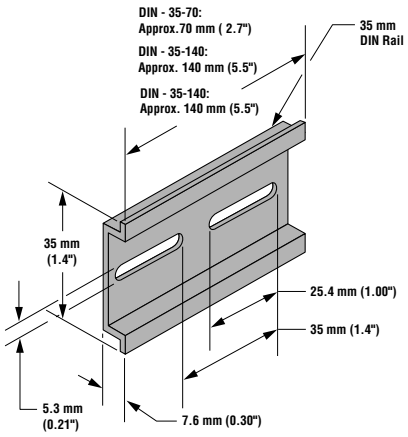
SP12 sensors may be fitted with apertures which narrow or shape the effective beam of the sensor and to protect the sensor's lens. These apertures are rectangular or circular thread-on water-tight parts. Use of apertures with SP12 high-gain sensors makes it possible to create very narrow, concentrated sensing beams for precision sensing applications. Both kits include lens, o-rings and thread-on housing.

Model	Description	
AP12SC	Includes 3 circular apertures with openings of: 0.5 mm (0.02") diameter 1.0 mm (0.04") diameter 2.5 mm (0.10") diameter	
AP12SR	Includes 3 rectangular apertures with openings of: 0.5 mm (0.02") wide 1.0 mm (0.04") wide 2.5 mm (0.10") wide	

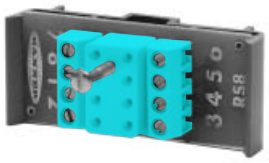
Mounting Brackets

Model	Description	Dimensions
SMB12MM 	• 12-gauge, stainless steel, right angle mounting bracket for SP12 series sensors • Curved mounting slot allows the bracket ±10° of lateral movement • Mounting holes accommodate M4 (#8) hardware	
SMB1812SF 	• 12 mm swivel for mounting SP12 series sensors • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	
SMB300 	• Steel right angle bracket designed for 2-axis mounting of SP300 series remote sensors • Clearance slot for mounting LR/PT400	
SMBSP3 	• 18-gauge stainless steel right-angle bracket for PICO-AMP SP3 and SP8 Series sensors	

35 mm DIN Rail Track

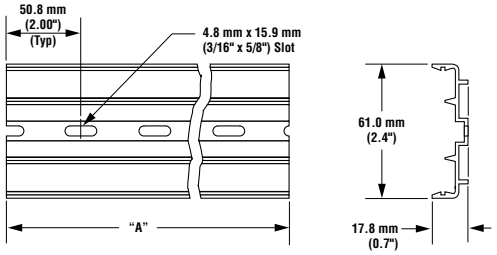
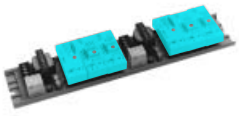
Model	Description	
DIN-35-70	70 mm track, accommodates up to 4 MD14 Amplifiers	
DIN-35-105	105 mm track, accommodates up to 6 MD14 Amplifiers	
DIN-35-140	140 mm track, accommodates up to 8 MD14 Amplifiers	

Sockets

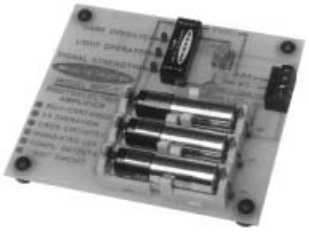
Model	Description	
RS8	• Used for mounting and wiring of MICRO-AMP module • Consists of a socket with two four-terminal connection strips, all wired together onto a PC board • The PC board assembly slides into a 25 mm (1") long PVC track which is used to mount the entire assembly • A hold-down screw keys the correct polarity of the module	
RS8K	• A kit, which is made up of the socket portion of the RS8, used to provide a socket for MICRO-AMP modules that are installed onto printed circuit boards • The kit consists of a molded socket block and 8 individual socket pins • A nylon screw is included to affix the socket block to the PC board • The drill size for the pins is #50 - 1.8 mm (0.070") • Drill pattern dimensions are included with the RS8K	

Mounting Tracks

PVC mounting track for MICRO-AMP components is available in 150 mm (6") and 300 mm (12") lengths for systems which use multiple components. For example, a 150 mm (6") length will accommodate one MPS-15 power supply plus two additional RS8 sockets with modules. Longer lengths of mounting track may be supplied on a quote basis.

Model	# of Slots	Length (A)	Dimensions	
TR100-1	1	25 mm (1") long		
TR100-4	2	100 mm (4") long		
TR100-6	3	150 mm (6") long		
TR100-12	8	300 mm (12") long		

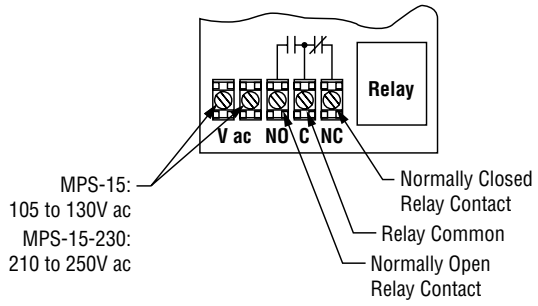
Demo Boards

Model	Description	
MA3DB	• Battery-powered demonstration/testing board used to evaluate or troubleshoot either the MA3, MA3AF or MA3-4 modulated amplifier and its sensor • It includes LED indicators for both outputs, a 4-pin terminal strip for sensor connections, and a 9-volt battery with holder; there is a socket for the MA3 or MA3-4 to plug into • Amplifier and sensor are sold separately NOTE: the MA3DB is NOT designed to work with models MA3P or MA3-4P, with current sourcing (PNP) outputs	
MPC3-DB	• Battery-powered (3 "AA" penlight batteries, included) demonstration/testing board used to evaluate or troubleshoot the MPC3 modulated amplifier and its sensor • It includes LED indicators for both outputs, plus the AID™ indicator, a plug-in MPC3, a sensitivity potentiometer and a 4-pin terminal strip to which the LED and receiver phototransistor may be connected • Sensors are sold separately	

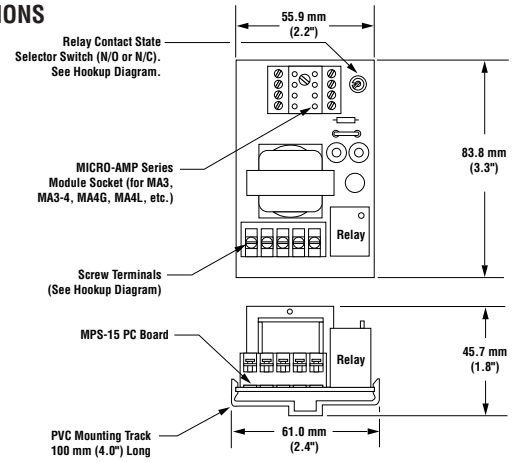
Power Supplies

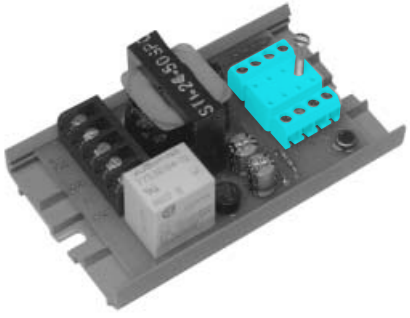
Model	Description
MPS-15 105 to 130V ac **MPS-15-230** 210 to 250V ac	• Designed specifically to supply power for Banner MICRO-AMP series amplifiers and logic modules • Constructed on small PC boards that are track mountable for compatibility with other track-mounted MICRO-AMP components • Built-in 5-amp rated SPDT output relay • Up to 3 MICRO-AMP modules may be powered by one MPS-15 power supply • Includes a socket for MICRO-AMP amplifier or logic module, 100mm (4") long mounting track • Optional 150 mm (6") track model TR100-6 (see previous page) is available to accommodate the MPS-15 series PC board plus the PC boards of two additional RS8 sockets to form a complete three-module MICRO-AMP sensing/logic system • **Output Type:** SPDT E/m **Contact rating:** 250V ac max., 30V dc max., 5 amps max. (resistive load) **Contact response:** 20 milliseconds open and close **Mechanical Life:** 10,000,000 operations **Temperature:** -40° to 70°C (-40° to +158°F) • **Compatible with modules models:** MA3, MA3AF, MA3-4, MA4-2, MA4G, MA4L and MA5

HOOKUP



DIMENSIONS

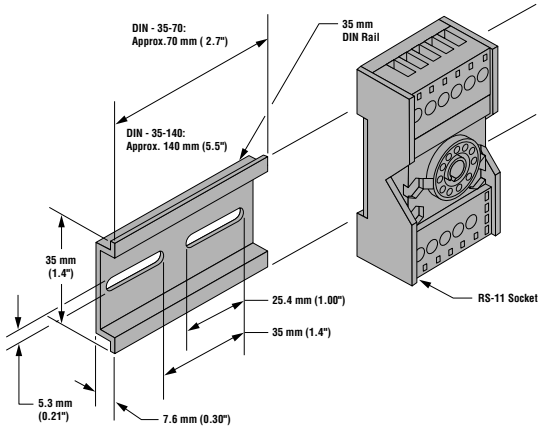




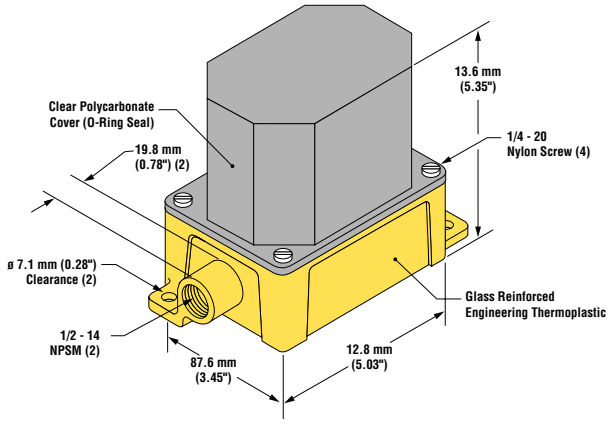
Socket

Model	Description	
RS-11	• 11-pole round-pin screw terminal relay socket which is used to make electrical connections to MAXI-AMP module • Provides in-line clamp screw terminals which will accept from one #24 AWG up to two #14 wires at each pin • May be mounted directly to a panel plate or via standard 35mm DIN-rail track • A MAXI-AMP hold-down wire is supplied with each RS-11 socket • UL recognized and CSA approved	

35 mm DIN Rail Track

Model	Description	
DIN-35-70	Track designed to accommodate RS-11 socket	
DIN-35-105	Track designed to hold 2 - RS-11 sockets	
DIN-35-140	Track designed to hold 3 - RS-11 sockets	

BENC-4 Enclosure

Model	Description	
BENC-4	• A NEMA-4X rated corrosion-resistant enclosure for a MAXI-AMP module or other control device • It is supplied with the DIN-35-70 track for easy mounting of one RS-11 socket	

NOTES:

D10 Sensors

D10 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

D10 *Expert*™ Series – Dual Discrete Outputs

Advanced Fiber-optic Amplifiers for Plastic Fibers

D10 *Expert* Sensing Mode Options

Plastic Fiber Optic

- Easy-to-set automatic Expert-style TEACH options* including static, dynamic, and single-point programming plus manual adjustment for fine-tuning
- 16-bit microcontroller and 12-bit Analog-to-Digital converter for high-performance, low-contrast sensing
- Easy-to-read 4-digit display for TEACH and signal strength readout, plus indicators for a continuous readout of operating status (user configurable)
- Two discrete outputs, PNP or NPN
- Four-mode power and speed selection with automatic cross-talk avoidance circuitry
- Selectable OFF-delay options
- Gate input wire can be used to selectively inhibit sensor outputs from switching
- Models available with visible red (680 nm) or visible green (525 nm) sensing beam
- Models available with 2 m or 9 m (6.5' or 30') cable or integral quick-disconnect
- Sleek, ultra-slim 10 mm housing, mounts to a standard 35 mm DIN rail

* U.S. Patent #5,808,296

See Sensing Beam Information Below

D10 *Expert* Series Plastic Fiber Optic – Dual Discrete Outputs

Models	Cable	Supply Voltage	Output Type	Range Specifications
Visible Red 680 nm				Range varies by Power Level/Speed Selection used and with fiber optics used. See data sheet part number 64154 for range information.
D10DNFP	2 m (6.5') cable	12 -24V dc	NPN (sinking)	
D10DNFPQ	6-pin Pico-style QD			
D10DPFP	2 m (6.5') cable		PNP (sourcing)	
D10DPFPQ	6-pin Pico-style QD			
Visible Green 525 nm				
D10DNFPG	2 m (6.5') cable	12 -24V dc	NPN (sinking)	
D10DNFPGQ	6-pin Pico-style QD			
D10DPFPG	2 m (6.5') cable		PNP (sourcing)	
D10DPFPGQ	6-pin Pico-style QD			

For D10 *Expert* Series:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **D10DNFP W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 601 and the Accessories section for more information.

D10 *Expert* Series Specifications – Dual Discrete Outputs

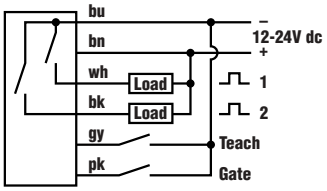
Required Fiber-Optic Cable	Banner P-Series plastic fibers (See Plastic Fiber Optic section, page 640)
Supply Voltage and Current	12 to 24V dc (10% maximum ripple) at less than 65 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltage.
Output Configuration	**Specify Model:** 2 NPN or 2 PNP
Output Rating	150 mA maximum load **OFF-state leakage current:** < 10 µA at 24V dc **ON-state saturation voltage:** NPN < 1.5V at 150 mA load PNP < 2.5V at 150 mA load
Output Protection Circuitry	Protected against false pulse on power-up and continuous short-circuit
Output Response Time	Programmable, 50 microseconds, 200 microseconds, 1 millisecond, 2.5 milliseconds NOTE: 150 millisecond delay on power-up; outputs do not conduct during this time.
Adjustments	Push-button or remote programming of response time, OFF-delay, light-dark operate, and display
Indicators	Four-digit digital display plus LCD indicators for active channel, push-button lockout, OFF-delay and light/dark operate selection. LCD backlight (red for Program mode or green for Run mode) indicates Power ON. Two amber output indicators
Construction	Black ABS/polycarbonate alloy (UL94 V-0 rated) housing, clear polycarbonate cover.
Environmental Rating	NEMA 1, IEC IP50
Connections	PVC-jacketed 2 m or 9 m (6.5' or 30') 6-wire integral cable or integral 6-pin Pico-style quick-disconnect
Operating Conditions	**Temperature:** -20° to +55°C (-4° to +131°F) **Storage Temperature:** -20° to +80°C (-4° to +175°F) **Max. Rel. Humidity:** 90% @ 50°C (non-condensing)

Number of Devices, Stacked	Ambient Temperature Rating	Load Specification
3	55°C	150 mA
7	50°C	50 mA
10	45°C	50 mA

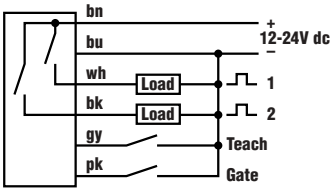
Installation	35 mm DIN rail or included mounting bracket

D10 *Expert* Series Hookups – Dual Discrete Outputs

D10DNFP(Q)

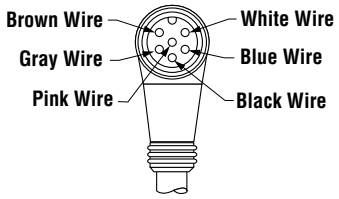


D10DPFP(Q)



NOTE: QD Hookups are identical.

6-Pin Pico-Style Pin-out (Connector on Cable Shown)



D10 *Expert*™ Series – Analog and Discrete Outputs

Advanced Fiber-optic Amplifiers for Plastic Fibers

- Easy-to-set automatic Expert-style TEACH options* including static, dynamic, and single-point programming plus manual adjust option for fine-tuning
- 16-bit microcontroller and 12-bit Analog-to-Digital converter for high-performance, low-contrast sensing
- Easy-to-read 4-digit display for TEACH and signal strength readout, plus indicators for a continuous readout of operating status (user configurable)
- Models available with one scalable Analog output (4-20 mA or 0-10V)** and one Discrete output (PNP or NPN)
- Four-mode power and speed selection with automatic cross-talk avoidance circuitry
- Selectable OFF-delay options
- Gate input wire can be used to selectively inhibit sensor outputs from switching
- Models available with visible red (680 nm) or visible green (525 nm) sensing beam
- Models available with 2 m or 9 m (6.5 ' or 30') cable or integral quick-disconnect
- Sleek, ultra-slim 10 mm housing, mounts to a standard 35 mm DIN rail

* U.S. Patent #5,808,296 ** U.S. Patent #6,122,039

D10 *Expert* Sensing Mode Options

Plastic Fiber Optic

See Sensing Beam Information Below

D10 *Expert* Series Plastic Fiber Optic – An alog and Discrete Outputs

Models	Cable	Supply Voltage	Discrete Output	Analog Output	Range Specifications
Visible Red 680 nm					Range varies by Power Level/Speed Selection used and with fiber optics used. See data sheet part number 65448 for range information.
D10INFP	2 m (6.5') cable	12 -24V dc	NPN (sinking)	4-20 mA	
D10INFPQ	6-pin Pico-style QD				
D10IPFP	2 m (6.5') cable		PNP (sourcing)		
D10IPFPQ	6-pin Pico-style QD				
D10UNFP	2 m (6.5') cable	15 -24V dc	NPN (sinking)	0-10V	
D10UNFPQ	6-pin Pico-style QD				
D10UPFP	2 m (6.5') cable		PNP (sourcing)		
D10UPFPQ	6-pin Pico-style QD				
Visible Green 525 nm					
D10INFPG	2 m (6.5') cable	12 -24V dc	NPN (sinking)	4-20 mA	
D10INFPGQ	6-pin Pico-style QD				
D10IPFPG	2 m (6.5') cable		PNP (sourcing)		
D10IPFPGQ	6-pin Pico-style QD				
D10UNFPG	2 m (6.5') cable	15 -24V dc	NPN (sinking)	0-10V	
D10UNFPGQ	6-pin Pico-style QD				
D10UPFPG	2 m (6.5') cable		PNP (sourcing)		
D10UPFPGQ	6-pin Pico-style QD				

D10 *Expert* Series Specifications – Analog and Discrete Outputs

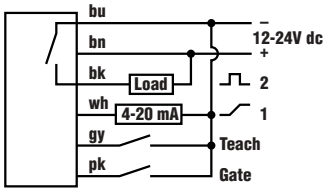
Required Fiber-Optic Cable	Banner P-Series plastic fibers (See Plastic Fiber Optic section, page 640)
Supply Voltage and Current	**4-20 mA Analog Models:** 12-24V dc (10% maximum ripple) at less than 65 mA exclusive of load **0-10V dc Analog Models:** 15-24V dc (10% maximum ripple) at less than 70 mA exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltage.
Output Configuration	**2 independently configurable outputs, depending on model:** NPN w/analog (4-20 mA or 0-10V) or PNP w/analog (4-20 mA or 0-10V)
Output Rating	**Discrete Output:** 150 mA, max. load **OFF-state leakage current:** < 10µA at 24V dc **ON-state saturation voltage:** NPN < 1.5V dc @ 150 mA PNP < 2.5V dc @ 150 mA **Analog Output:** 4-20 mA or 0-10V dc **Load:** 4-20 mA Models: 100Ω max. impedance 0-10V dc Models: 1 MΩ max. impedance
Output Protection Circuitry	Protected against false pulse on power-up and continuous short-circuit
Output Response Time	**Discrete Output:** Programmable, 50 microseconds, 200 microseconds, 1 millisecond, 2.5 milliseconds **Analog Output:** 1 millisecond NOTE: 150 millisecond delay on power-up; outputs do not conduct during this time.
Adjustments	Push-button or remote programming of response time, OFF-delay, light-dark operate, and display
Indicators	Four-digit digital display plus LCD indicators for active channel, push-button lockout, OFF-delay and light/dark operate selection. LCD backlight (red for Program mode or green for Run mode) indicates Power ON. Two amber output indicators
Construction	Black ABS/polycarbonate alloy (UL94 V-0 rated) housing, clear polycarbonate cover.
Environmental Rating	NEMA 1, IEC IP50
Connections	PVC-jacketed 2 m or 9 m (6.5' or 30') 6-wire integral cable or integral 6-pin Pico-style quick-disconnect
Operating Conditions	**Temperature:** -20° to +55°C (-4° to +131°F) **Storage Temperature:** -20° to +80°C (-4° to +175°F) **Max. Rel. Humidity:** 90% @ 50°C (non-condensing)

Number of Devices, Stacked	Ambient Temperature Rating	Load Specification (discrete output)
3	55°C	150 mA
7	50°C	50 mA
10	45°C	50 mA

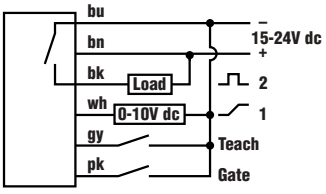
Installation	35 mm DIN rail or included mounting bracket

D10 *Expert* Series Hookups – Analog and Discrete Outputs

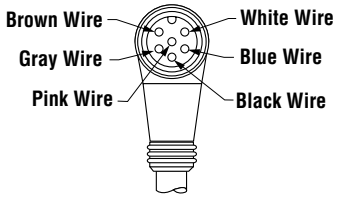
D10INFP(Q)



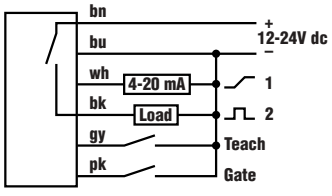
D10UNFP(Q)



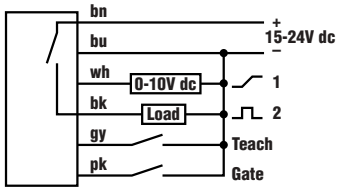
6-Pin Pico-Style Pin-out (Connector on Cable Shown)



D10IPFP(Q)



D10UPFP(Q)



NOTE: QD Hookups are identical.

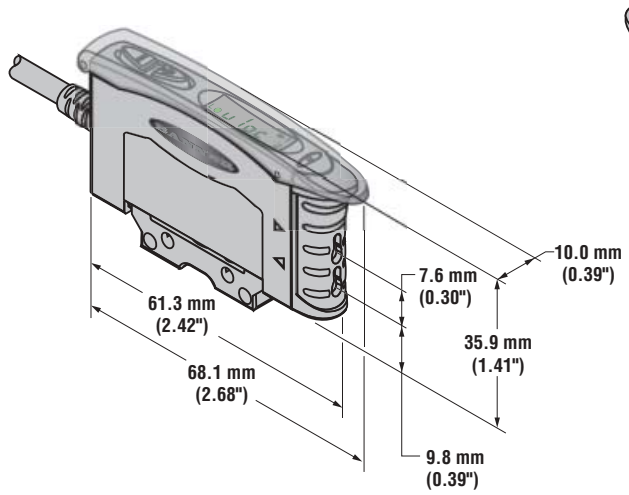
For D10 *Expert* Series:

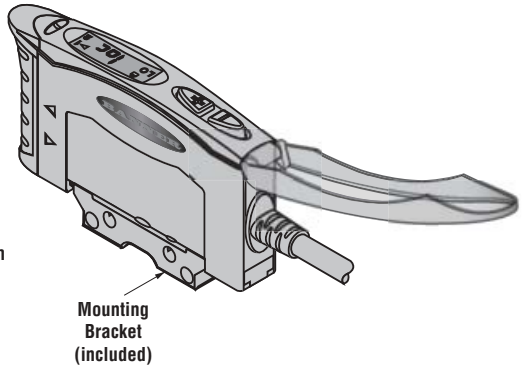
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **D10INFP W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 601 and the Accessories section for more information.

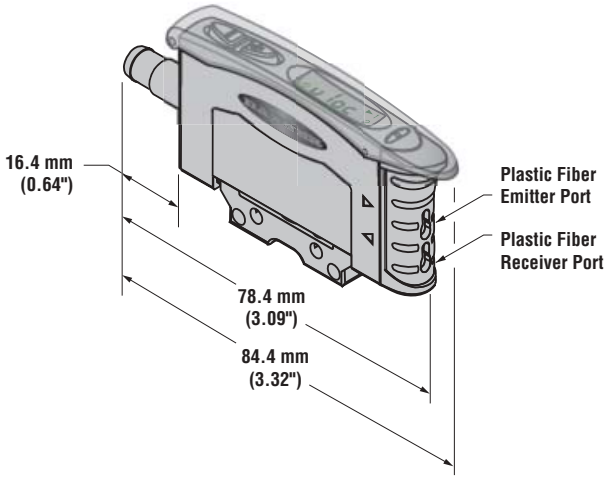
D10 *Expert* Series Dimensions

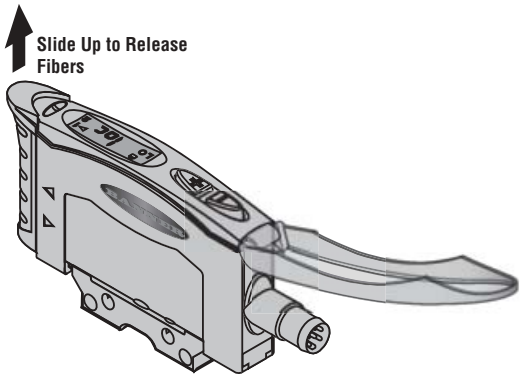
D10 Series with Cable Attached



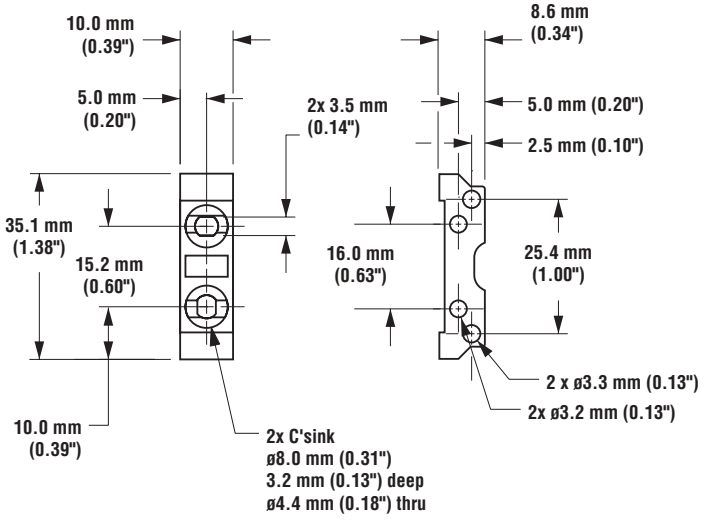


D10 Series with Quick-Disconnect





Bracket



Modifications

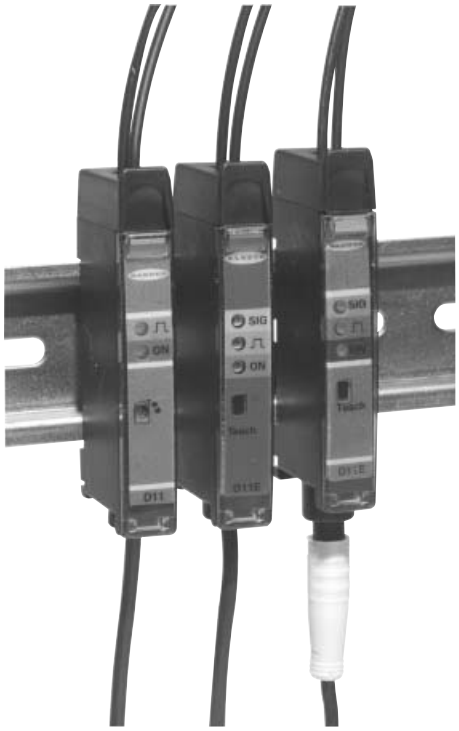
Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All D10 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	D10DNFP W/30

Quick-Disconnect (QD) Cables

The following is a selection of cables available for the D10 QD models. See the Accessories section for more information.

Style	Model	Length	Connector	For Use With
6-Pin Pico	**PKG6Z-2** **PKG6Z-9** **PKW6Z-2** **PKW6Z-9**	2 m (6.5') 9 m (30') 2 m (6.5') 9 m (30')	Straight Straight Right-Angle Right-Angle	All D10 Sensors

NOTES:



D11 Sensors

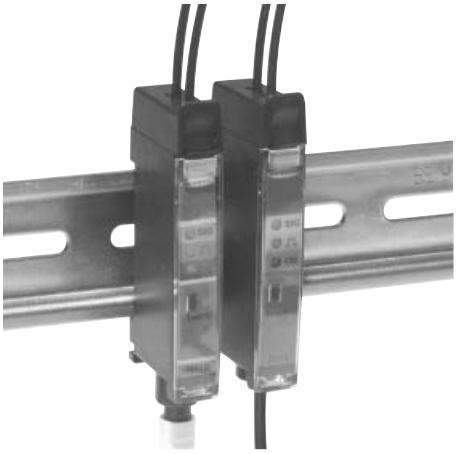
CE Except Visible Green & Blue Models

c UL us

⚠ D11 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

D11 *Expert*™ Series Sensors

Low Cost, TEACH-Mode Sensors

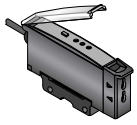


- Easy push button TEACH-mode programming automatically adjusts sensitivity to optimal setting
- Designed for high-performance, even in low contrast sensing applications (sensitivity set to just above the "dark" condition)
- D11E2 Series sensors set the switching point midway between the "dark" and "light" conditions to ignore subtle changes, such as web flutter
- Fast, 200 microsecond (0.2 millisecond) output response; a 40 millisecond output pulse stretcher may be programmed, when needed
- Choose models with NPN (sinking) or PNP (sourcing) output
- Output may be programmed for either light or dark operate
- Sealed one-button programming† assures security of settings
- LED status indications for power "ON", output state, received signal strength, sensing contrast, and diagnostic trouble conditions
- Choose models with integral 2 m (6.5') cable or pico-style quick-disconnect (QD) connector; 9 m (30') cables are also available

†U.S. Patent Pending

D11 *Expert* Sensing Mode Options

Plastic Fi



Visible red, 680 nm

D11 *Expert* Series Plastic Fiber Optic

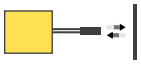
Models	Switching Threshold Setting	Cable	Supply Voltage	Output Type	Maximum Range Specifications Diffuse mode performance based on 90% reflectance white test card
D11EN6FP **D11EN6FPQ**	Just above the "dark" condition	2 m (6.5') 4-pin Pico QD	10-30V dc	NPN (sinking)	Range varies by sensing mode and fiber optics used: PIT46U fibers, opposed mode: 180 mm (7.1")* PIT26U fibers, opposed mode: 50 mm (2.0") PBT46U fiber, diffuse mode: 50 mm (2.0") PBT26U fiber, diffuse mode: 10 mm (0.4") * Opposed mode range may be extended using optional lenses (see Plastic Fiber Optic section for available lenses).
D11EP6FP **D11EP6FPQ**		2 m (6.5') 4-pin Pico QD		PNP (sourcing)	
D11E2N6FP **D11E2N6FPQ**	Midway between "dark" and "light" conditions	2 m (6.5') 4-pin Pico QD		NPN (sinking)	
D11E2P6FP **D11E2P6FPQ**		2 m (6.5') 4-pin Pico QD		PNP (sourcing)	

For D11 Expert Series:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **D11EN6FP W/30**)

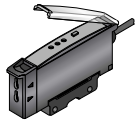
ii) A model with a QD connector requires an accessory mating cable. See page 615 and the Accessories section for more information.

iii) 5 volt models are available. Contact factory for more information.



See Sensing Beam Information Below

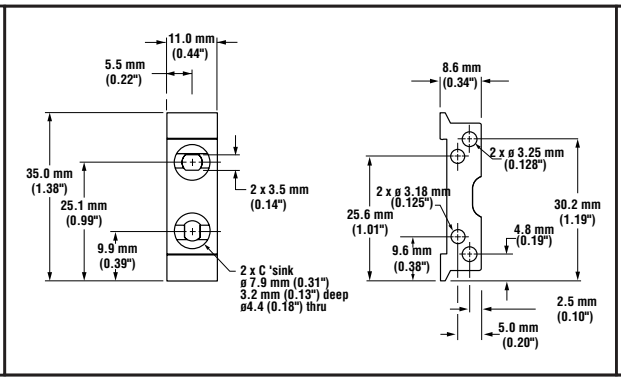
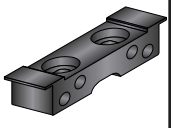
Model with green, blue, or white LED light source are recommended for color mark sensing. Contact your local or factory sales engineer for model selection assistance.



D11 *Expert* Series Plastic Fiber Optic

Models	Cable	Supply Voltage	Output Type	Maximum Range Specifications Diffuse mode performance based on 90% reflectance white test card
Visible Green 525 nm				Range varies by sensing mode and fiber optics used: PIT46U fibers, opposed mode: 50 mm (2.0")* PIT26U fibers, opposed mode: 80 mm (3.1") PBT46U fiber, diffuse mode: 17 mm (0.7") PBT26U fiber, diffuse mode: 25 mm (1.0") * Opposed mode range may be extended using optional lenses (see Plastic Fiber Optic section for available lenses).
D11EN6FPG **D11EN6FPGQ**	2 m (6.5') 4-pin Pico QD	10-30V dc	NPN (sinking)	
D11EP6FPG **D11EP6FPGQ**	2 m (6.5') 4-pin Pico QD		PNP (sourcing)	
Visible Blue 470 nm				
D11EN6FPB **D11EN6FPBQ**	2 m (6.5') 4-pin Pico QD	10-30V dc	NPN (sinking)	
D11EP6FPB **D11EP6FPBQ**	2 m (6.5') 4-pin Pico QD		PNP (sourcing)	
Visible White 450 - 650 nm				
D11EN6FPW **D11EN6FPWQ**	2 m (6.5') 4-pin Pico QD	10-30V dc	NPN (sinking)	
D11EP6FPW **D11EP6FPWQ**	2 m (6.5') 4-pin Pico QD		PNP (sourcing)	

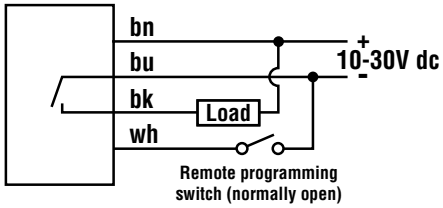
D11 *Expert* Series Specifications

Supply Voltage and Current	10 to 30V dc (10% maximum ripple) at less than 45 mA, exclusive of load
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	One (SPST) NPN (sinking) or PNP (sourcing) open-collector transistor, depending on model; programmable for light or dark operate
Output Rating	150 mA maximum; **Off-state leakage current:** <5 microamps at 30V dc **On-state saturation voltage** <1V at 10 mA dc; <1.5V at 150 mA dc
Output Protection Circuitry	Protected against false pulse on power-up and continuous overload or short circuit
Output Response Time	200 microseconds (0.2 milliseconds) "ON" and "OFF" (40 milliseconds "OFF" when pulse stretcher is programmed) NOTE: 100 millisecond delay on power-up: output is non-conducting during this time
Output Timing Functions	ON/OFF (no delay) or fixed 40 millisecond OFF-Delay pulse stretcher; selected by push button
Repeatability	65 microseconds
Adjustments	Push button teach mode sensitivity setting; remote teach mode input is provided
Indicators	Three LEDs: Green, Yellow and Red **Green LED** lights for dc power "ON" and flashes when ready to register sensing condition during TEACH mode; 1 Hz when waiting to learn first sensing condition; 2 Hz when waiting to learn second sensing condition, 4 Hz when output is overloaded **Yellow LED** lights for output "ON" (conducting) **Red LED** is Banner's patented Alignment Indicating Device (AID™, U.S. patent #4356393) which lights whenever the sensor "sees" a light condition and superimposes a pulse rate which is proportional to the strength of the received light signal (the stronger the signal, the faster the pulse rate)
Construction	Black ABS (Cycolac® KJB) housing with acrylic cover; stainless steel M3 x 0.5 hardware for use with ABS (Cycolac® KJB) mounting bracket (supplied); requires PI or PB Series plastic fiber cable
Mounting Bracket	D11 Sensors mount directly to a standard 35 mm DIN rail, or may be through-hole mounted using the supplied mounting bracket and M3 x 0.5 hardware  
Environmental Rating	IEC IP54; NEMA 2
Connections	2 m (6.5') or 9 m (30') attached cable, or 4-pin pico-style quick-disconnect fitting; cables for QD models are purchased separately
Operating Conditions	**Temperature:** -10° to +55°C (+14° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	

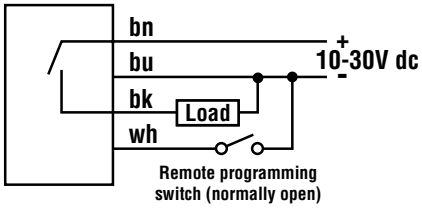
Cycolac® is a registered trademark of General Electric Co.

D11 *Expert* Series Hookup Diagrams

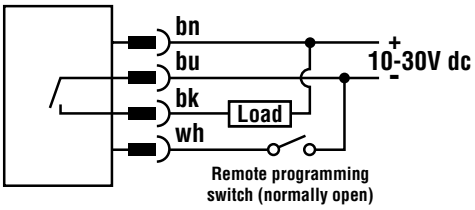
Sensors with NPN (Sinking) Outputs with Attached Cable



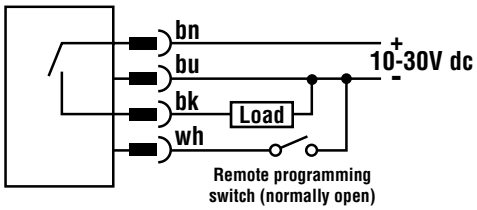
Sensors with PNP (Sourcing) Outputs with Attached Cable



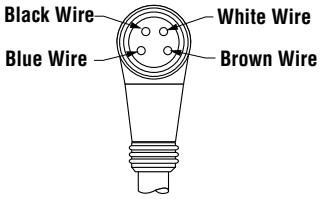
Sensors with NPN (Sinking) Outputs with Quick-Disconnect



Sensors with PNP (Sourcing) Outputs with Quick-Disconnect



4-Pin Pico-Style Pin-out (Connector on Cable Shown)



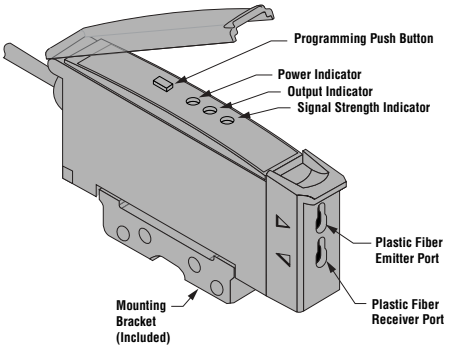
Quick-Disconnect (QD) Option

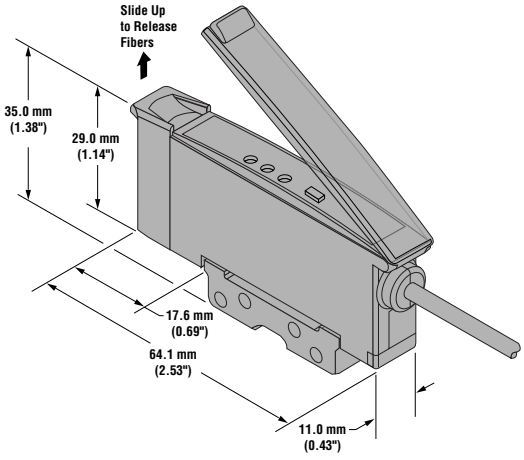
D11 Expert Series sensors are sold either with a 2 m (6.5') or 9 m (30') attached PVC-covered cable or with a 4-pin pico-style QD cable fitting.

D11 Expert Series sensors are identified by the letter “Q” in their model number suffix. Mating cables for QD sensors are model PKG4-2 (straight connector) or PKW4-2 (right-angled connector). Cables are supplied in a standard length of 2 m (6.5'). For more information on QD cable, see page 615 and the Accessories section.

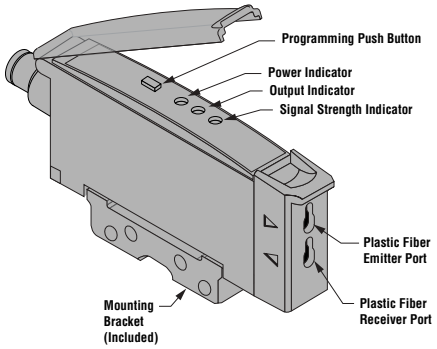
D11 *Expert* Series Dimensions

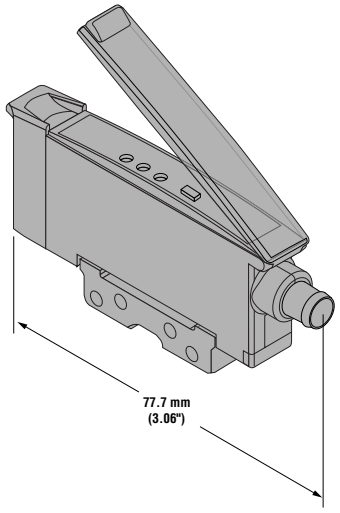
D11 *Expert* Series with Cable Attached



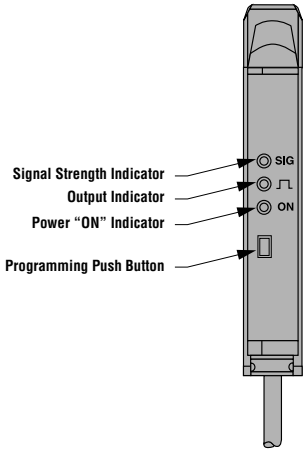


D11 *Expert* Series with Quick-Disconnect





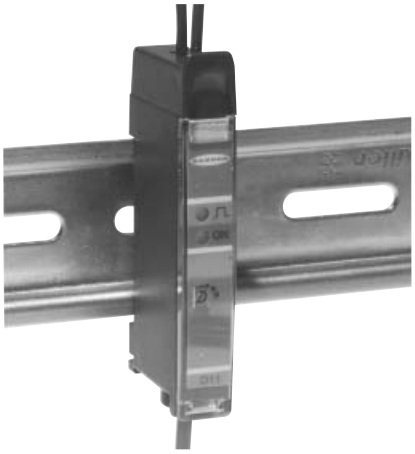
D11 *Expert* Series Features Top View



NOTES:

D11 Series Sensors

Low Cost, Self-contained Sensors

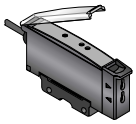


- Choice of NPN (sinking) or PNP (sourcing) complementary outputs - one normally open and one normally closed; 150 mA output load rating
- Normally-closed output may be wired as a diagnostic alarm to alert personnel to marginal sensing conditions†
- 500 microsecond (0.5 millisecond) output response
- LED status indications for Power ON, Output Overload, Fiber Alignment, and Marginal Gain conditions†
- Choose models with integral 2 m (6.5') cable or pico-style quick-disconnect (QD) connector; 9 m (30') cables are also available

†U.S. Patent #5087838

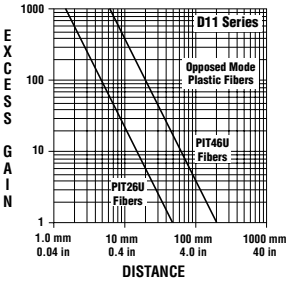
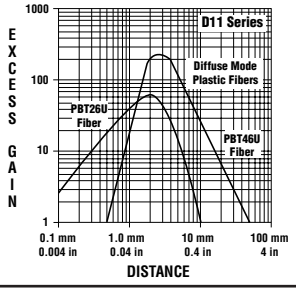
D11 Series Sensing Mode Options

Plastic Fiber Optic



Visible red, 680 nm

D11 Series Plastic Fiber Optic

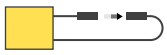
Models	Range	Cable	Supply Voltage	Output Type	Excess Gain Diffuse mode performance based on 90% reflectance white test card
D11SN6FP **D11SN6FPQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-pin Pico QD	10-30V dc	Comple-mentary NPN (sinking)	
D11SP6FP **D11SP6FPQ**		2 m (6.5') 4-pin Pico QD		Comple-mentary PNP (sourcing)	

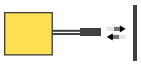
For D11 Series:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **D11SN6FP W/30**)

ii) A model with a QD connector requires an accessory mating cable. See page 615 and the Accessories section for more information.

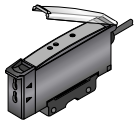
iii) 5 volt models are available. Contact factory for more information.





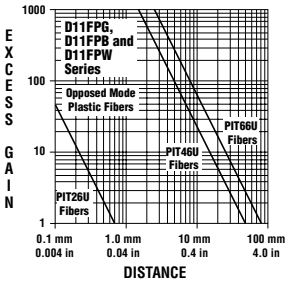
See Sensing Beam Information Below

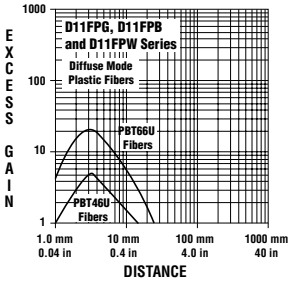
Models with green, blue, or white LED light source are recommended for color mark sensing. Contact your local or factory sales engineer for model selection assistance.



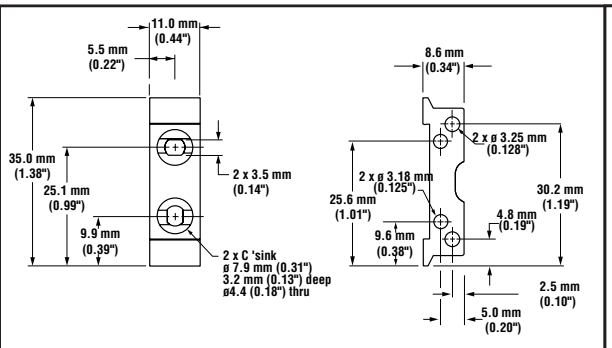
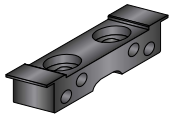
D11 Series Plastic Fiber Optic

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain Diffuse mode performance based on 90% reflectance white test card
Visible Green 525 nm					
D11SN6FPG **D11SN6FPGQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-pin Pico QD	10-30V dc	Complementary NPN (sinking)	
D11SP6FPG **D11SP6FPGQ**		2 m (6.5') 4-pin Pico QD		Complementary PNP (sourcing)	
Visible Blue 470 nm					
D11SN6FPB **D11SN6FPBQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-pin Pico QD	10-30V dc	Complementary NPN (sinking)	
D11SP6FPB **D11SP6FPBQ**		2 m (6.5') 4-pin Pico QD		Complementary PNP (sourcing)	
Visible White 450 - 650 nm					
D11SN6FPW **D11SN6FPWQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-pin Pico QD	10-30V dc	Complementary NPN (sinking)	
D11SP6FPW **D11SP6FPWQ**		2 m (6.5') 4-pin Pico QD		Complementary PNP (sourcing)	





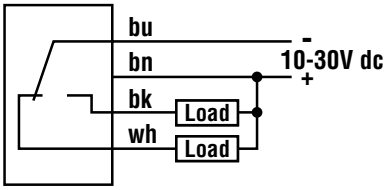
D11 Series Specifications

Supply Voltage and Current	10 to 30V dc at 25 mA (exclusive of load current)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Complementary: one normally open (N.O.) and the other normally closed (N.C.); N.C. output may be wired as diagnostic alarm output by reversing power supply connections† (see Hookups); outputs are NPN (Sinking) or PNP (Sourcing), depending on model † U.S. Patent #5087838 Diagnostic alarm output energizes whenever excess gain falls to between 1x and 1.5x in the light condition; this output corresponds to flashing yellow indicator LED
Output Rating	150 mA maximum (each output); the total load may not exceed 150 mA **Off-state leakage current:** <5 microamps at 30V dc **On-state saturation voltage** <1V at 10 mA dc; <1.5V at 150 mA dc
Output Protection Circuitry	Protected against false pulse on power-up (false pulse protection circuit causes a 0.1 second delay on power-up); short circuit protected
Output Response Time	500 microseconds “ON” and “OFF”
Repeatability	160 microseconds; response time and repeatability are independent of signal strength
Adjustments	SENSITIVITY control on top of module (15-turn slotted brass screw, clutched at both ends of travel)
Indicators	Two LEDs: Green and Yellow **GREEN** glowing steadily = power to sensor is “ON” **GREEN** flashing = output is overloaded **YELLOW** glowing steadily = normally open output is conducting **YELLOW** flashing = marginal excess gain (1-1.5x) in light condition = alarm output “ON”
Construction	Black ABS (Cycolac® KJB) housing with acrylic cover; stainless steel M3 x 0.5 hardware for use with ABS (Cycolac® KJB) mounting bracket (supplied); requires PI or PB Series plastic fiber cable
Mounting Bracket	D11 Sensors mount directly to a standard 35 mm DIN rail, or may be through-hole mounted using the supplied mounting bracket and M3 x 0.5 hardware  
Environmental Rating	IEC IP54 (NEMA 2)
Connections	2 m (6.5') or 9 m (30') attached cable, or 4-pin pico-style quick-disconnect fitting; cables for QD models are purchased separately
Operating Conditions	**Temperature:** -20° to +55°C (-4° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	

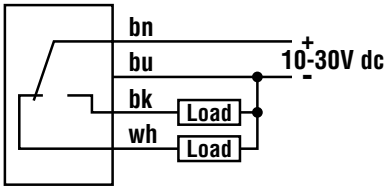
Cycolac® is a registered trademark of General Electric Co.

D11 Series Hookup Diagrams

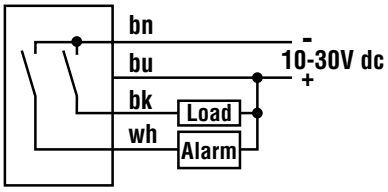
Sensors with NPN (Sinking) Outputs Standard Hookup



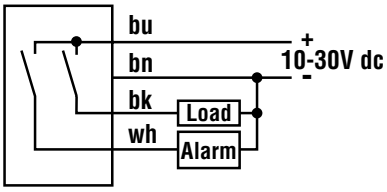
Sensors with PNP (Sourcing) Outputs Standard Hookup



Alarm Hookup

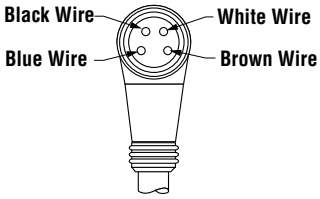


Alarm Hookup



Note: Connections are the same for either an integral cable or QD cable.

4-Pin Pico-Style Pin-out (Connector on Cable Shown)



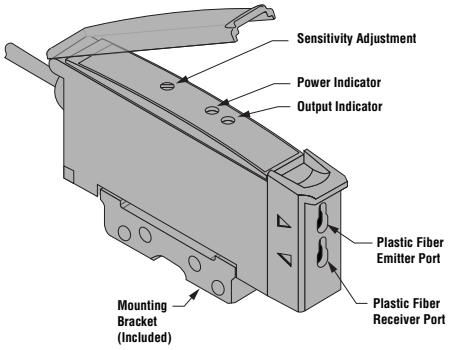
Quick-Disconnect (QD) Option

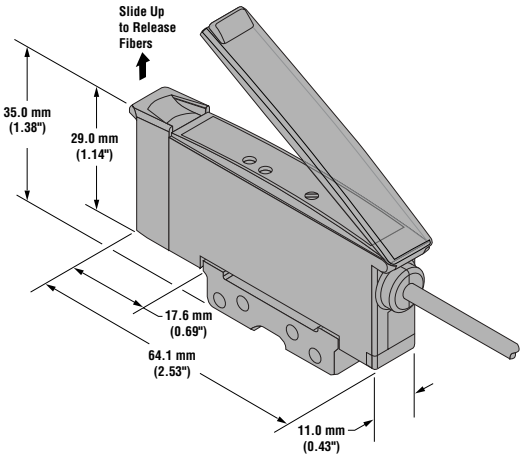
D11 Series sensors are sold either with a 2 m (6.5') or 9 m (30') attached PVC-covered cable or with a 4-pin pico-style QD cable fitting.

D11 Series sensors are identified by the letter “Q” in their model number suffix. Mating cables for QD sensors are model PKG4-2 (straight connector) or PKW4-2 (right-angled connector). Cables are supplied in a standard length of 2 m (6.5'). For more information on QD cable, see page 615 and the Accessories section.

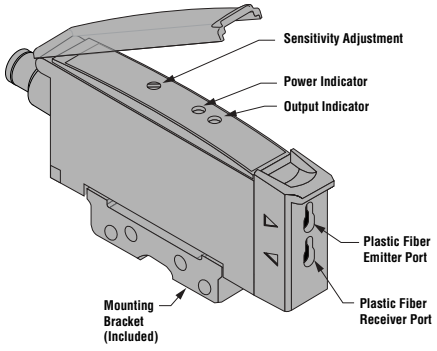
D11 Series Dimensions

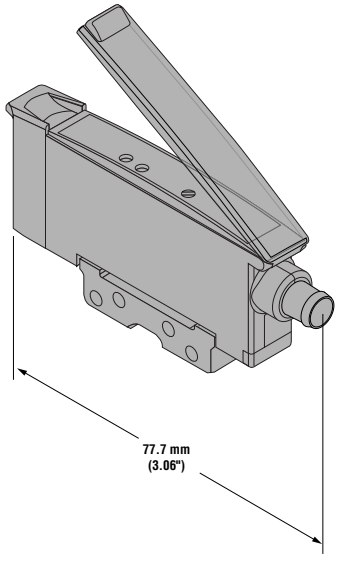
D11 Series with Cable Attached



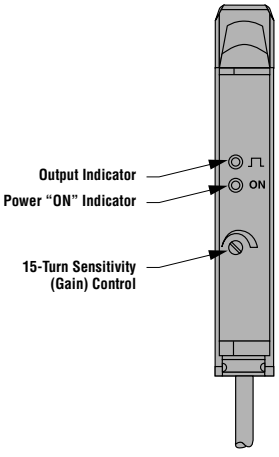


D11 Series with Quick-Disconnect





D11 Series Features
Top View



Modifications

Model Suffix	Modification	Description	Example of Model Number
W/30	9 m (30') cable	All D11 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable	D11EN6FP W/30

Quick-Disconnect (QD) Cables

The following is a selection of cables available for the D11 QD models. See the Accessories section for more information.

Style	Model	Length	Connector	For Use With
4-Pin Pico	**PKG4-2** **PKW4-2**	2 m (6.5') 2 m (6.5')	Straight Right-Angle	All D11 Sensors

NOTES:

D12 Sensors

CE cULus (Except AC-Coupled models on both approvals)

D12 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

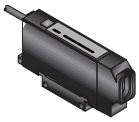
D12 *Expert*™ Teach Mode Fiber Optic Sensors

D12 *Expert* Sensing Mode Options

Glass and Plastic Fiber Optic

- Easy TEACH-mode programming automatically adjusts sensitivity to optimal setting*
- D12E sensors are designed for low-contrast sensing applications (switching threshold set to just above the “dark” condition)
- D12E2 sensors set their switching threshold midway between “dark” and “light” conditions to ignore subtle changes, such as web flutter
- Models for either plastic or glass fiber optics; choose models with NPN (sinking) or PNP (sourcing) output
- Fast 200 microsecond sensing response; a 40 millisecond pulse stretcher may be programmed, when needed
- Output may be programmed for either light- or dark-operate
- Secure one-button programming is easy to use; one button sets both TEACH and sensor configuration settings
- Separate input for remote sensor programming by external switch, such as a switch or process controller
- 7-segment LED bargraph† indicates relative received signal strength and sensing contrast, programming status and diagnostic trouble warnings
- Dedicated alarm output for signaling marginal sensing conditions

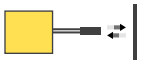
*U.S. Patent #5808296
† U.S. Patent #4965548



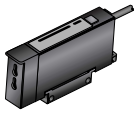
Visible red, 680 nm

D12 *Expert* Series Glass Fiber Optic

Models	Switching Threshold Setting	Cable	Supply Voltage	Output Type	Maximum Range (Diffuse mode performance based on 90% reflectance white test card)
D12EN6FV **D12EP6FV**	Just above the “dark” condition	2 m (6.5')	10-30V dc	NPN	Range varies by sensing mode and fiber optics used: IT23S fibers, opposed mode: 930 mm (36.6")* IT13S fibers, opposed mode: 442 mm (17.4") BT23S fiber, diffuse mode: 178 mm (7.0") BT13S fiber, diffuse mode: 68 mm (2.7") *Opposed mode range may be extended using optional lenses (see Accessories in the glass fiber optic section)
				PNP	
D12E2N6FV **D12E2P6FV**	Midway between “dark” and “light” conditions			NPN	
				PNP	



Visible red, 660 nm



D12 *Expert* Series Plastic Fiber Optic

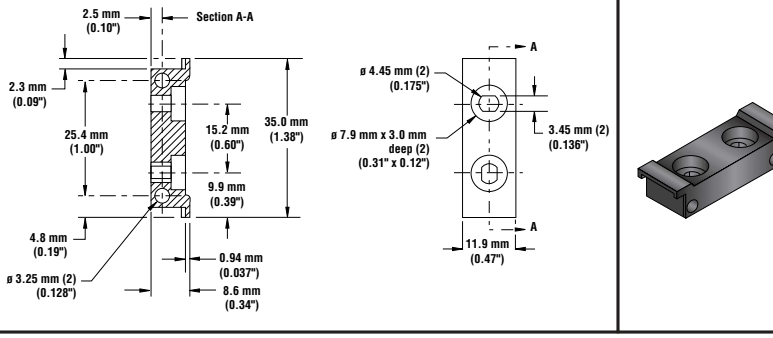
Models	Switching Threshold Setting	Cable	Supply Voltage	Output Type	Maximum Range Diffuse mode performance based on 90% reflectance white test card
D12EN6FP **D12EP6FP**	Just above the “dark” condition	2 m (6.5')	10-30V dc	NPN	PIT46U fibers, opposed mode: 315 mm (12.4")* PIT26U fibers, opposed mode: 84 mm (3.3") PBT46U fiber, diffuse mode: 95 mm (3.7") PBT26U fiber, diffuse mode: 25 mm (1") *Opposed mode range may be extended using optional lenses (see Accessories in the plastic fiber optic section)
				PNP	
D12E2N6FP **D12E2P6FP**	Midway between “dark” and “light” conditions			NPN	
				PNP	

For D12 Expert Series Sensors:

i) 9 m (30') cables are available by adding suffix **“W/30”** to the model number of any cabled sensor (e.g. - **D12EN6FP W/30**)

D12 *Expert* Series Specifications

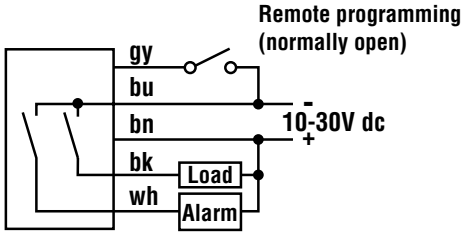
Supply Voltage and Current	10 to 30V dc at 45 mA max. (exclusive of load); 10% maximum ripple
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	**NPN** open collector (both outputs) or **PNP** open collector (both outputs), depending on model; **Load output:** N.O. and programmable light- or dark-operate; **Alarm output:** N.O.
Output Rating	150 mA maximum each output **Off-state leakage current** less than 10 microamps at 30V dc **On-state saturation voltage** less than 1 volt at 10 mA dc and less than 1.5 volts at 150 mA dc. **The total load may not exceed 150 mA**
Output Protection Circuitry	Protected against false pulse on power-up and short circuit of outputs
Output Response Time	200 microseconds on/off (40 milliseconds OFF when OFF-delay selected) (NOTE: False pulse protection circuit causes a 0.1 second delay on power-up)
Output Operation Mode	Light operate or dark operate: selected by push button
Output Timing Functions	ON/OFF (no delay) or fixed 40 millisecond OFF-delay; selected by push button
Repeatability	66 microseconds
Adjustments	Push button teach mode sensitivity setting; Remote teaching input is provided
Indicators	**GREEN LED** lights for DC power ON and flashes when ready for teach mode; 1 Hz when ready to learn first condition; 2 Hz for second condition **YELLOW LED** lights for load output ON (conducting) 7-segment moving dot red LED display indicates relative received light signal strength, output program settings, relative contrast level and alarm
Construction	Black ABS (Cycolac® KJB) housing with acrylic cover, stainless steel M3 x 0.5 hardware for use with thermoplastic polyester mounting bracket (supplied); the plastic fiber clamping element is Delrin®
Environmental Rating	Rated NEMA 4; IEC IP66
Mounting Bracket	D12 Sensors mount directly to a standard DIN rail, or may be through-hole mounted using the supplied mounting bracket and M3 x 0.5 hardware
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables
Operating Conditions	**Temperature:** -20° to +70°C (-5° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	



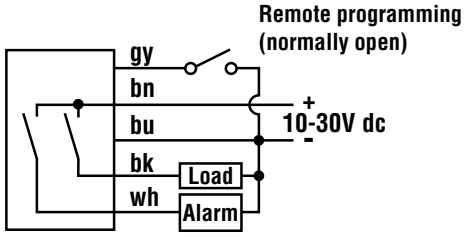
Cycolac® is a registered trademark of General Electric Co.; Delrin® is a registered trademark of Dupont

D12 *Expert* Series Hookup Diagrams

D12 *Expert* with NPN (Sinking) Outputs

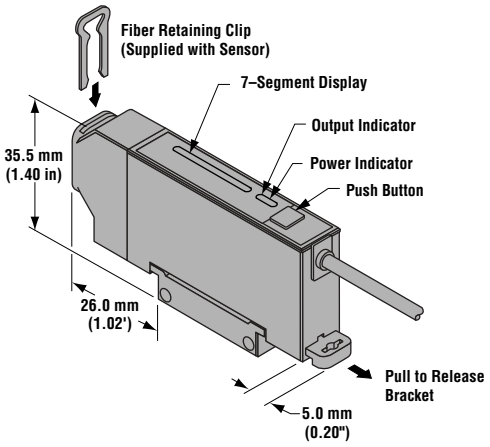


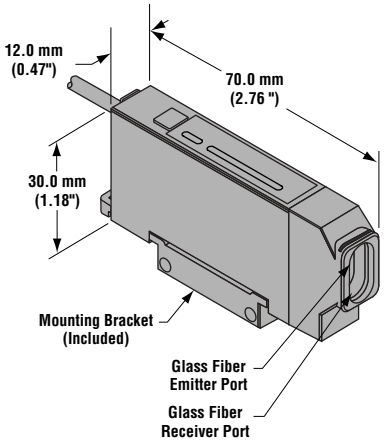
D12 *Expert* with PNP (Sourcing) Outputs



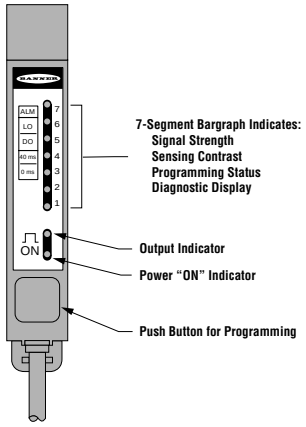
D12 *Expert* Series Dimensions

D12 *Expert* Series - Glass Fiber Optic Models

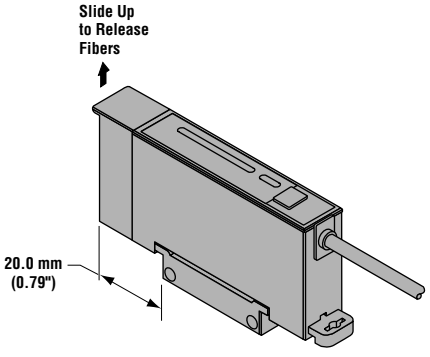


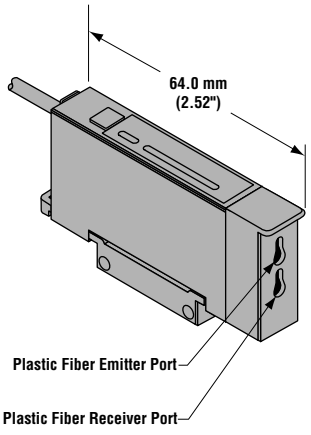


D12 *Expert* Series Features Top View



D12 *Expert* Series - Plastic Fiber Optic Models





D12 Standard, High Speed and High Power Sensors

- Models for use with either Banner glass or plastic fiber optic assemblies
- Standard models have fast 500 microsecond (0.5 millisecond) output response; high speed models (model suffix "Y" or "Y1") have selectable 500 or 50 microsecond response
- Choice of either NPN (sinking) or PNP (sourcing) complementary outputs; 150mA output load rating
- Normally-closed output of standard models may be wired as a diagnostic alarm output to alert personnel of marginal sensing conditions*
- 7-segment LED bargraph† (all models) indicates: received signal strength, output overload, and marginal signal strength (NOTE: bargraph is inoperative in the 50 microsecond mode of high speed models)
- Separate LED indicators for sensor power and output status
- "Y1" suffix high speed models include a 20 millisecond output pulse stretcher
- Choose models with integral 2 m (6.5') cable or 150 mm (6 in) pico-style pigtail QD; 9 m (30') cables are also available

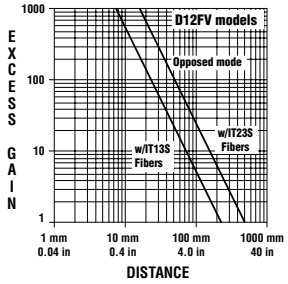
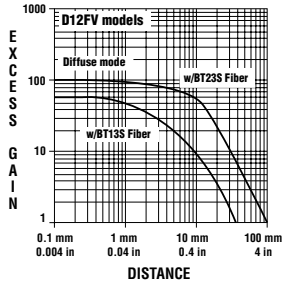
*U.S. Patent #5087838
† U.S. Patent #4965548

D12 Standard, High Speed and High Power Sensing Mode Options

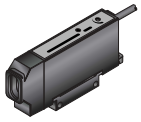
Glass and Plastic Fiber Optic

Visible red, 680 nm

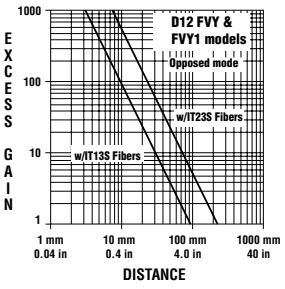
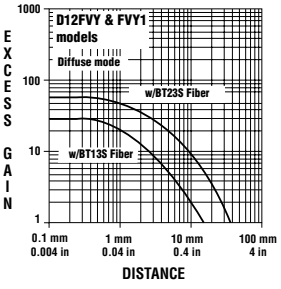
D12 Standard Glass Fiber Optic (500 µs Output Response)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain (Diffuse mode performance based on 90% reflectance white test card)
D12SN6FV **D12SN6FVQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Pico Pigtail QD	10-30V dc	Comple-mentary NPN	
D12SP6FV **D12SP6FVQ**		2 m (6.5') 4-Pin Pico Pigtail QD		Comple-mentary PNP	

Visible red, 680 nm



D12 High Speed Glass Fiber Optic (50 µs or 500 µs Output Response)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain Diffuse mode performance based on 90% reflectance white test card
D12SN6FVY **D12SN6FVYQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Pico Pigtail QD	10-30V dc	Comple-mentary NPN	
D12SN6FVY1* **D12SN6FVY1Q***		2 m (6.5') 4-Pin Pico Pigtail QD			
D12SP6FVY **D12SP6FVYQ**		2 m (6.5') 4-Pin Pico Pigtail QD		Comple-mentary PNP	
D12SP6FVY1* **D12SP6FVY1Q***		2 m (6.5') 4-Pin Pico Pigtail QD			

* Y1 models have 20 ms output pulse stretcher

For D12 Standard, High Speed and High Power Sensors:

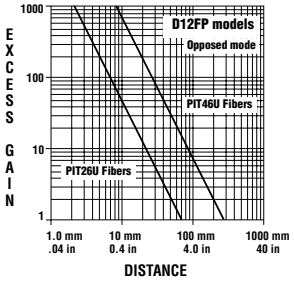
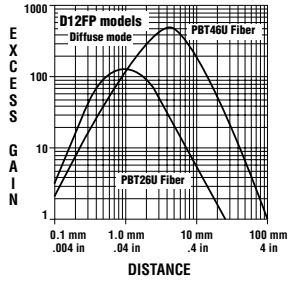
i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **D12SP6FV W/30**)

ii) Quick disconnect models (suffix "Q") have a 150 mm (6") long pigtail cable with a Pico-style connector. See page 634 for more information.

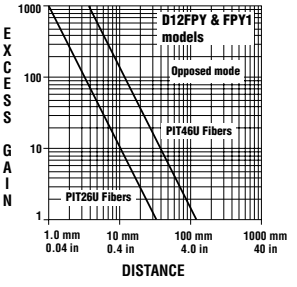
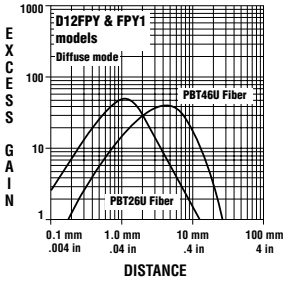
iii) A model with a QD connector requires an accessory mating cable. See page 634 and the Accessories section for more information.

Visible red, 680 nm

D12 Standard Plastic Fiber Optic (500 µs Output Response)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain Diffuse mode performance based on 90% reflectance white test card
D12SN6FP **D12SN6FPQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Pico Pigtail QD	10-30V dc	Complementary NPN	
D12SP6FP **D12SP6FPQ**		2 m (6.5') 4-Pin Pico Pigtail QD		Complementary PNP	

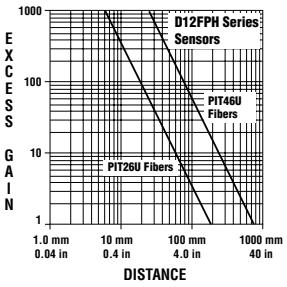
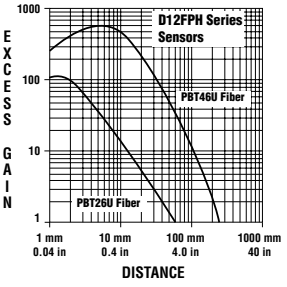
D12 High Speed Plastic Fiber Optic (50 µs or 500 µs Output Response)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain Diffuse mode performance based on 90% reflectance white test card
D12SN6FPY **D12SN6FPYQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Pico Pigtail QD	10-30V dc	Complementary NPN	
D12SN6FPY1* **D12SN6FPY1Q***		2 m (6.5') 4-Pin Pico Pigtail QD			
D12SP6FPY **D12SP6FPYQ**		2 m (6.5') 4-Pin Pico Pigtail QD		Complementary PNP	
D12SP6FPY1* **D12SP6FPY1Q***		2 m (6.5') 4-Pin Pico Pigtail QD			

* Y1 models have 20 ms output pulse stretcher

Visible red, 660 nm

D12 High Power Plastic Fiber Optic (500 µs Output Response)

Models	Range	Cable	Supply Voltage	Output Type	Excess Gain Diffuse mode performance based on 90% reflectance white test card
D12SN6FPH **D12SN6FPHQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Pico Pigtail QD	10-30V dc	Comple-mentary NPN	
D12SP6FPH **D12SP6FPHQ**		2 m (6.5') 4-Pin Pico Pigtail QD		Comple-mentary PNP	

NOTE: D12 High Power models for glass fiber optics are available by special order

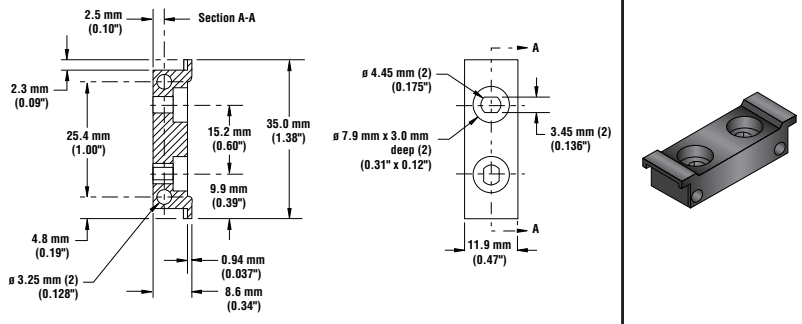
For D12 Standard/High Speed/High Power Standard, High Speed and High Power Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **D12SN6FPH W/30**)

ii) Quick disconnect models (suffix "Q") have a 150 mm (6") long pigtail cable with a Pico-style connector. See page 634 for more information.

iii) A model with a QD connector requires an accessory mating cable. See page 634 and the Accessories section for more information.

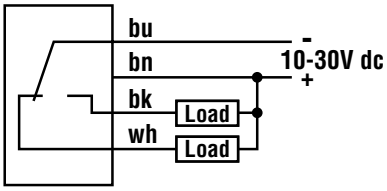
D12 Standard, High Speed and High Power Specifications

Supply Voltage and Current	10 to 30V dc at 45 mA max. (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Outputs are NPN (sinking) or PNP (sourcing), depending on model Complementary: one normally open (N.O.) and the other normally closed (N.C.); N.C.output may be wired as diagnostic alarm output by reversing power supply connections except high speed "Y" and "Y1" suffix models (see hookups)
Output Rating	150 mA maximum each output **Off-state leakage current** less than 10 microamps at 30V dc **On-state saturation voltage** less than 1 volt at 10 mA dc and less than 1.5 volts at 150 mA dc **The total load may not exceed 150 mA**
Output Protection Circuitry	Protected against false pulse on power-up and short circuit of outputs
Output Response Time	**Standard and High Power Models:** 500 microseconds on/off; **High Speed Models:** selectable 50 or 500 microseconds on/off (NOTE: False pulse protection circuit causes a 0.1 second delay on power-up)
Output Timing Functions	"Y1" models have fixed 20 ms pulse stretcher (off-delay) when 50 µs mode is used
Repeatability	130 microseconds; "Y" and "Y1" models have selectable 50 µs/500 µs response;repeatability in 50 µs mode is 15 µs
Adjustments	All models have a SENSITIVITY control on top of sensor (15-turn slotted brass screw, clutched at both ends of adjustment); "Y" and "Y1" (high speed models) also have a top-mounted response mode selector switch
Indicators	Two top-mounted LED indicators, one yellow and one green, and one 7-segment red LED moving dot bargraph; Note that the 7-segment bargraph and marginal excess gain indication (bargraph segment #7) are inoperative in the 50µs response mode of "Y" and "Y1" models **GREEN LED** lights for DC Power On **YELLOW LED** lights for NORMALLY OPEN OUTPUT CONDUCTING On all models in 500µs response mode, the 7-segment moving dot red LED bargraph lights to indicate relative received light signal strength; On all models in 50 and 500µs response mode, segment #1 flashes to indicate OUTPUT OVERLOAD; On all models in the 500 µs response mode, segment #7 flashes to indicate MARGINAL EXCESS GAIN; On standard and high power models, a flashing LED corresponds to the "on" state of the alarm output; (Alarm output not available on Y & Y1 models)
Construction	Black ABS (Cycolac® KJB) housing with acrylic cover, stainless steel M3 x 0.5 hardware for use with thermoplastic polyester mounting bracket (supplied); the plastic fiber clamping element is Delrin®
Mounting Bracket	D12 Sensors mount directly to a standard DIN rail, or may be through-hole mounted using the supplied mounting bracket and M3 x 0.5 hardware 
Environmental Rating	Rated NEMA 4; IEC IP66
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or 150 mm 4-pin pico-style quick-disconnect (QD) pigtail fitting are available. QD cables are ordered separately. See page 634 and the Accessories section.
Operating Conditions	**Temperature:** -20° to +70°C (-4° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Certifications	CE c UL us

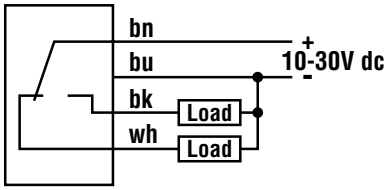
Cycolac® is a registered trademark of General Electric Co.; Delrin® is a registered trademark of Dupont

D12 Standard/High Speed/High Power Hookup Diagrams

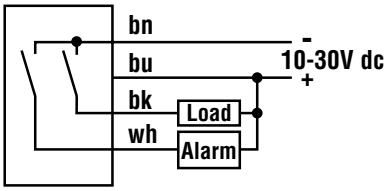
D12 Sensors with NPN (Sinking) Outputs Standard Hookup



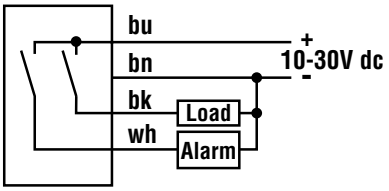
D12 Sensors with PNP (Sourcing) Outputs Standard Hookup



Alarm Hookup*



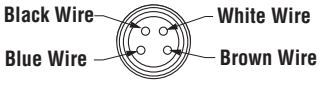
Alarm Hookup*



*NOTE[1]: High speed models (model suffix “Y” and “Y1”) use Standard Hookup only.

NOTE: Hookups are the same for either and integral cable or QD cable. QD connector pin configuration is as seen below.

4-Pin Pico-Style Pin-out (Connector on Cable Shown)



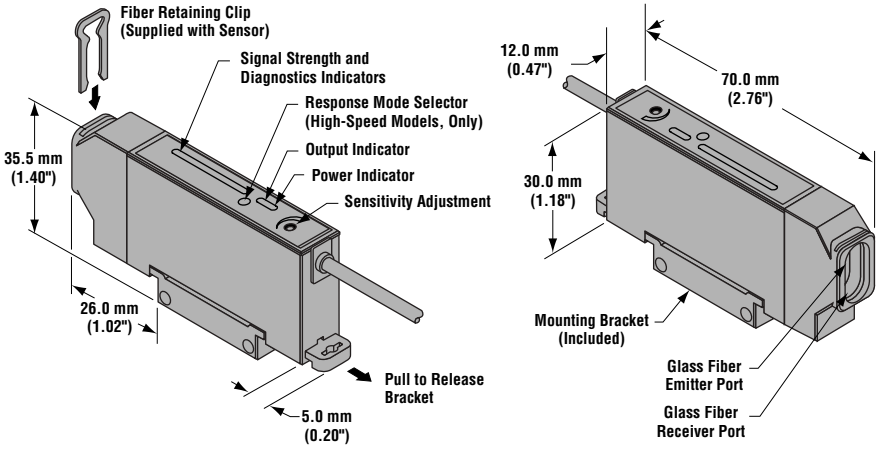
Quick-Disconnect (QD) Option

D12 Standard/High Speed/High Power Sensors are sold either with a 2 m (6.5') or 9 m (30') attached PVC-covered cable or with a 150 mm (6") 4-pin pico-style pigtail QD cable fitting.

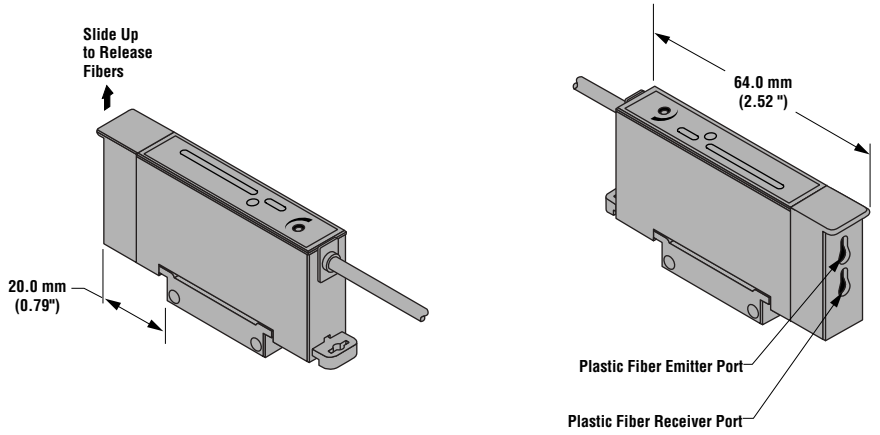
D12 Standard/High Speed/High Power QD sensors are identified by the letter “Q” in their model number suffix. Mating cable for QD sensors is model PKG4-2 (straight connector). Cables are supplied in a standard length of 2 m (6.5'). For more information on QD cable, see page 634 and the Accessories section.

D12 Standard/High Speed/High Power Dimensions

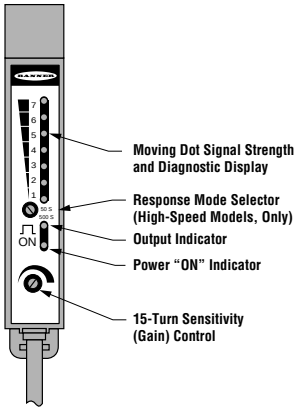
D12 Standard/High Speed Sensors - Glass Fiber Optic Models



D12 Standard/High Speed/High Power Sensors - Plastic Fiber Optic Models



D12 Standard/High Speed/High Power Sensors Features
Top View



NOTES:

D12 AC-Coupled Sensors

D12DAB6FP Plastic Fiber Optic Sensor, Mounted on a DIN Rail with a Bifurcated Plastic Fiber Optic Assembly Attached

- Highly sensitive to very small signal change; fast response
- Automatic gain control circuit continually adjusts emitter output to maintain system gain
- Ideal for low contrast applications such as web flaw, thread break and falling part detection
- Bipolar outputs: one NPN (sinking) and one PNP (sourcing)
- LED indicators for sensor power, output status and AGC lock condition
- Selectable light- or dark-operate; no false pulse on power-up
- Adjustable output pulse time
- Models for both plastic and glass fiber optics

D12 AC-Coupled Sensing Mode Options

Glass and Plastic Fiber Optic

Visible red, 680 nm

D12 AC-Coupled Series Glass Fiber Optic (50 µs Output Response)

Models	Range	Cable	Supply Voltage	Output Type	Maximum Range Diffuse mode performance based on 90% reflectance white test card
D12DAB6FV **D12DAB6FVQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Pico Pigtail QD	10-30V dc	Bipolar NPN/PNP	IT23S fibers, opposed mode: 200 mm (8")* IT13S fibers, opposed mode: 75 mm (3") BT23S fiber, diffuse mode: 60 mm (2.5") BT13S fiber, diffuse mode: 25 mm (1") *Opposed mode range may be extended using optional lenses (see Accessories in the glass fiber optic section)

For D12 AC-Coupled Sensors:

i) 9 m (30') cables are available by adding suffix **"W/30"** to the model number of any cabled sensor (e.g. - **D12DAB6FV W/30**)

ii) Quick disconnect models (suffix "Q") have a 150 mm (6") long pigtail cable with a Pico-style connector. See page 634 for more information.

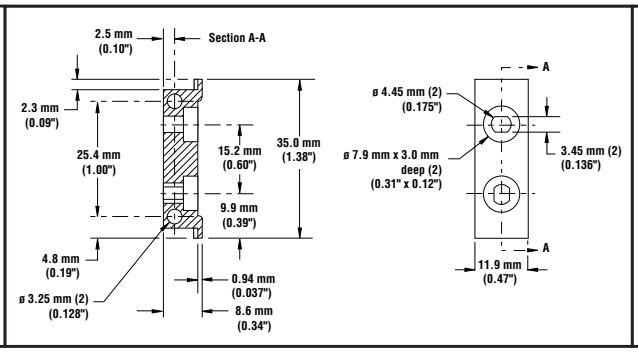
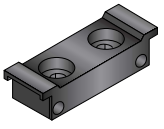
iii) A model with a QD connector requires an accessory mating cable. See page 634 and the Accessories section for more information.

Visible red, 680 nm

D12 AC-Coupled Series Plastic Fiber Optic (50 µs Output Response)

Models	Range	Cable	Supply Voltage	Output Type	Maximum Range Diffuse mode performance based on 90% reflectance white test card
D12DAB6FP **D12DAB6FPQ**	Range varies by sensing mode and fiber optics used	2 m (6.5') 4-Pin Pico Pigtail QD	10-30V dc	Bipolar NPN/PNP	PIT46U fibers, opposed mode: 76 mm (3")* PIT26U fibers, opposed mode: 13 mm (0.5") PBT46U fiber, diffuse mode: 25 mm (1") PBT26U fiber, diffuse mode: 5 mm (0.2") *Opposed mode range may be extended using optional lenses (see Accessories in the plastic fiber optic section)

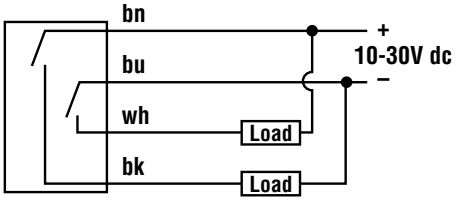
D12 AC-Coupled Series Specifications

Supply Voltage and Current	10 to 30V dc at 60 mA max. (exclusive of load)
Supply Protection Circuitry	Protected against reverse polarity and transient voltages
Output Configuration	Bipolar: one NPN (current sinking) and one PNP (current sourcing) open-collector transistor
Output Rating	150 mA maximum each output **Off-state leakage current** less than 10 microamps at 30V dc **On-state saturation voltage** less than 1 volt at 10 mA dc and less than 1.5 volts at 150 mA dc **The total load may not exceed 150 mA**
Output Protection Circuitry	Protected against false pulse on power-up and short circuit of outputs
Output Response Time	50 microseconds on/off (NOTE: False pulse protection circuit causes a 0.1 second delay on power-up)
Output Operation Mode	Light operate or dark operate: selected by switch
Output Timing Functions	Pulse output; adjustable from 1 to 70 milliseconds
Repeatability	15 microseconds “on”
Adjustments	Three top-panel controls: SENSITIVITY control (15-turn slotted brass screw, clutched at both ends of adjustment), a light- or dark-operate select switch, and an OUTPUT PULSE adjustment (3/4-turn potentiometer)
Indicators	Three top-mounted LED indicators: **GREEN LED** lights to indicate dc Power On **YELLOW LED** lights for Output Conducting **RED LED** lights whenever AGC system is locked onto the signal
Construction	Black ABS (Cycolac® KJB) housing with acrylic cover, stainless steel M3 x 0.5 hardware for use with thermoplastic polyester mounting bracket (supplied); the plastic fiber clamping element is Delrin®
Mounting Bracket	D12 Sensors mount directly to a standard DIN rail, or may be through-hole mounted using the supplied mounting bracket and M3 x 0.5 hardware  
Environmental Rating	Rated NEMA 4; IEC IP66
Connections	PVC-jacketed 2 m (6.5') or 9 m (30') cables, or 150 mm 4-pin pico-style quick-disconnect (QD) pigtail fitting are available. QD cables are ordered separately. See page 634 and the Accessories section.
Operating Conditions	**Temperature:** -40° to +70°C (-40° to +158°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)
Application Note	D12 AC-coupled sensors should not be used in areas of known electrical “noise” or RF fields.

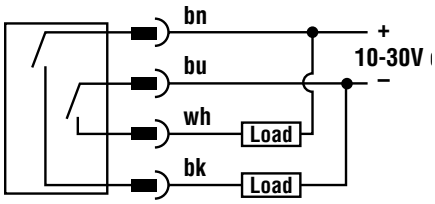
Cycolac® is a registered trademark of General Electric Co.; Delrin® is a registered trademark of Dupont

D12 AC-Coupled Series Hookup Diagrams

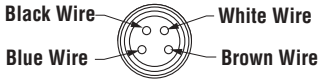
D12 AC-Coupled with Attached Cable



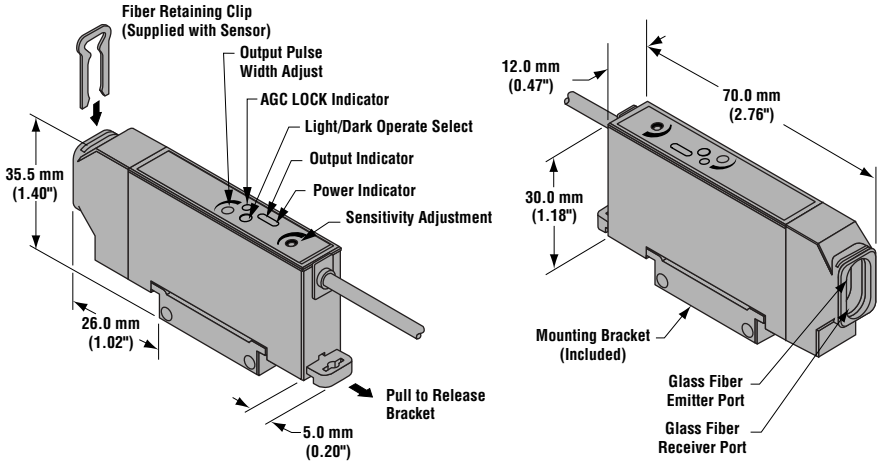
D12 AC-Coupled with Quick-Disconnect



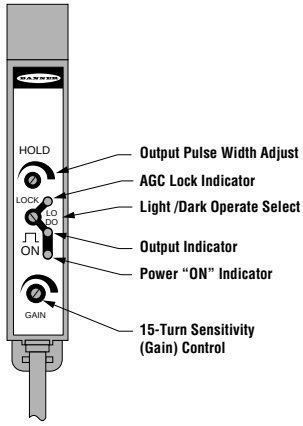
4-Pin Pico-Style Pin-out (Connector on Cable Shown)



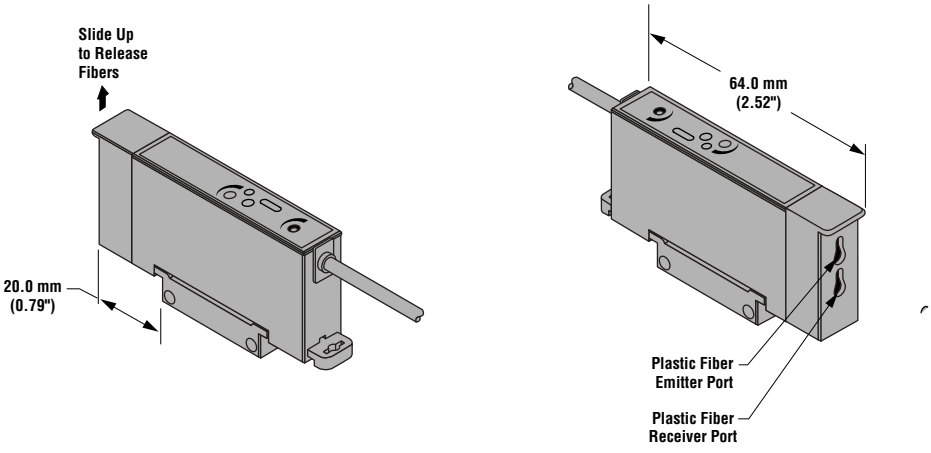
D12 AC-Coupled Series - Glass Fiber Optic Models



D12 AC-Coupled Series Features Top View



D12 AC-Coupled Series - Plastic Fiber Optic Models

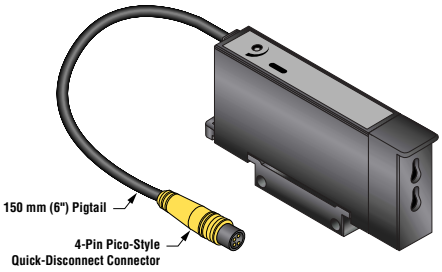


Quick-Disconnect (QD) Option

D12 AC-Coupled Sensors are sold either with a 2 m (6.5') or 9 m (30') attached PVC-covered cable or with a 150 mm (6") 4-pin pico-style pigtail QD cable fitting.

D12 AC-Coupled QD sensors are identified by the letter "Q" in their model number suffix. Mating cable for QD sensors is model PKG4-2 (straight connector). Cables are supplied in a standard length of 2 m (6.5'). For more information on QD cable, see page 634 and the Accessories section.

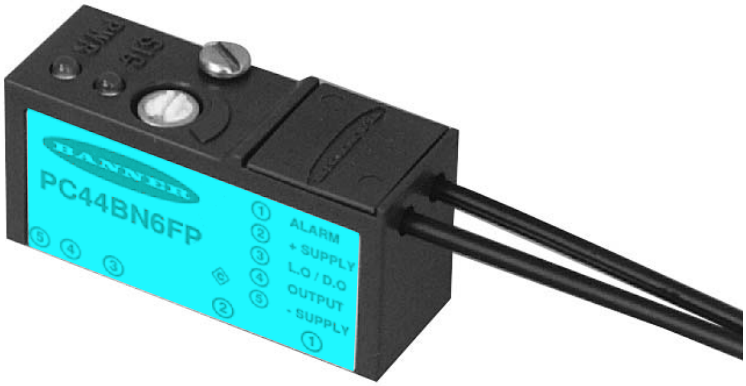
Modifications

Model Suffix	Modification	Description		Example of Model Number
W/30	9 m (30') cable	All D12 sensors may be ordered with an integral 9 m (30') cable in place of the standard 2 m (6.5') cable		D12SN6FP W/30
Q	150 mm 4-Pin Pico-Style Pigtail Quick-Disconnect NOTE: Not available for D12 Expert Series	All D12 sensors (except D12 Expert Series) may be built with a 150 mm (6") long integral cable which is terminated with the appropriate QD connector. See the Accessories section for more information.		D12SN6FPHQ

Quick-Disconnect (QD) Cables

The following is a selection of cables available for the D12 QD models. See the Accessories section for more information.

Style	Model	Length	Connector	For use with:
4-Pin Pico	**PKG4-2**	2 m (6.5')	Straight	All D12 Sensors (except for D12 Expert Series)

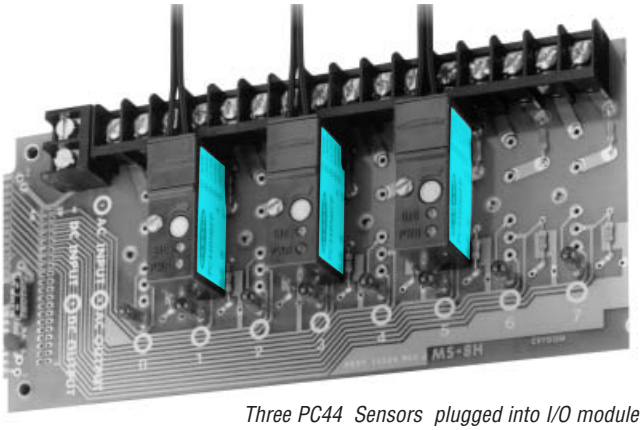


PC44 Sensors

PC44 sensors are not suitable for use in personnel safety applications! See WARNING on inside front cover of catalog.

PC44 Sensors

Plug-in Sensing Controls for Plastic Fiber Optics

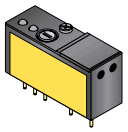


Three PC44 Sensors plugged into I/O module

- For use with Banner 1 mm (0.04") diameter plastic fiber optic assemblies
- Two models available; select NPN (current sinking) or PNP (current sourcing) outputs
- Both models have two outputs: Load and Alarm; both outputs rated for 100 mA maximum
- Alarm output conducts whenever excess gain in the light condition falls below 1.5x
- PC44 sensors may be soldered directly to a printed circuit board; optional socket pin kit model PCJ-25 (25 PC board sockets per kit) is available
- Connect pin #3 to +V dc for dark operate or leave unconnected for light operate (see hookup diagrams)
- Use with any Banner 1 mm (0.04") diameter plastic fiber optic assembly
- Easy fiber installation - simply push fibers into place and snap gripper door closed

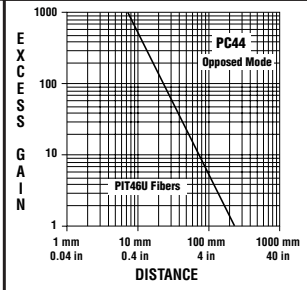
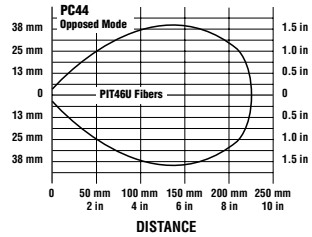
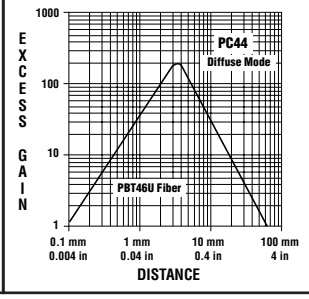
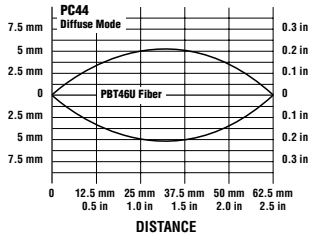
PC44 Sensing Mode Options

Plastic Fiber Optic



Visible red, 680 nm

PC44 Plastic Fiber Optic

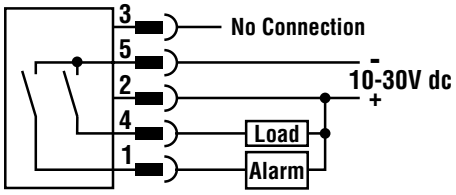
Models	Range	Supply Voltage	Output Type	Excess Gain	Beam Pattern
				Diffuse mode performance based on 90% reflectance white test card	
PC44BN6FP	Range varies by sensing mode and fiber optics used	10-30V dc	NPN		
PC44BP6FP			PNP		

PC44 Specifications

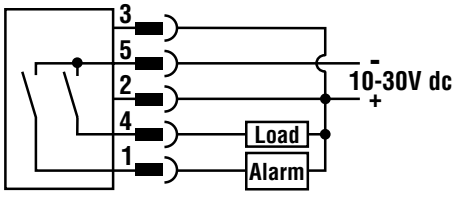
Supply Voltage and Current	10 to 30V dc at 25 mA maximum, exclusive of load, at module pins #2 (+V dc) and #5 (dc common); 10% maximum ripple
Supply Protection Circuitry	Protected against reverse polarity
Output Configuration	Solid-state dc output, selectable for light- or dark-operate: PC44BN6FP = NPN sinking load output plus NPN sinking alarm output PC44BP6FP = PNP sourcing load output plus PNP sourcing alarm output *Light operate mode:* Normally open load output conducts when the receiver sees the emitter's modulated visible red light *Dark operate mode:* Normally open load output conducts when the receiver does not see the emitter's modulated light
Module Output Rating	100 mA maximum each output **Off-state leakage** current is less than 1 microamp at 30V dc **On-state saturation** voltage is less than 1 volt at 10 mA dc and less than 1.5 volts at 100 mA dc When the alarm output is used, the total load may not exceed 100 mA
Output Protection Circuitry	Protected against false pulse on power-up and overload or short circuit of outputs
Output Response Time	1 millisecond ON and OFF; independent of signal strength; Repeatability: 0.25 milliseconds (NOTE: False pulse protection circuit causes 100 millisecond delay on power-up)
Indicators	Two top-mounted LED indicators: GREEN glowing steadily = dc power "ON" GREEN flashing = output overloaded YELLOW glowing steadily = excess gain in light condition is >1.5x YELLOW flashing = excess gain in light condition is marginal (<1.5x) Flashing YELLOW corresponds to a conducting (closed) alarm output
Construction	Polypropylene housing, gold-plated copper connecting pins, totally epoxy-encapsulated, sealed and plated steel mounting (hold-down) screw
Operating Conditions	**Temperature:** -20° to +50°C (-5° to +131°F) **Maximum relative humidity:** 90% at 50°C (non-condensing)

PC44 DC Hookup Diagrams

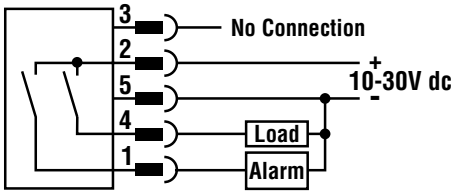
Model PC44BN6FP - NPN (Sinking) - Light Operate



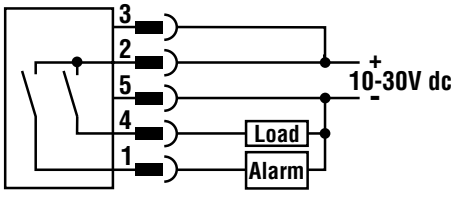
Model PC44BN6FP - NPN (Sinking) - Dark Operate



Model PC44BP6FP - PNP (Sourcing) - Light Operate

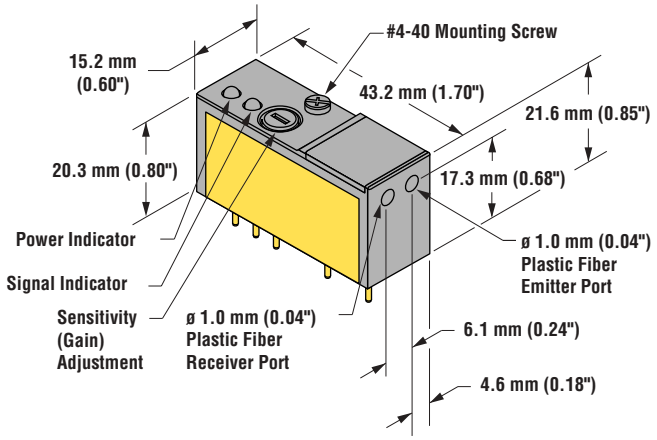


Model PC44BP6FP - PNP (Sourcing) - Dark Operate

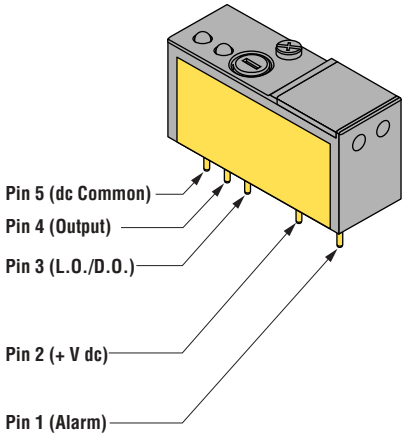


PC44 Dimensions

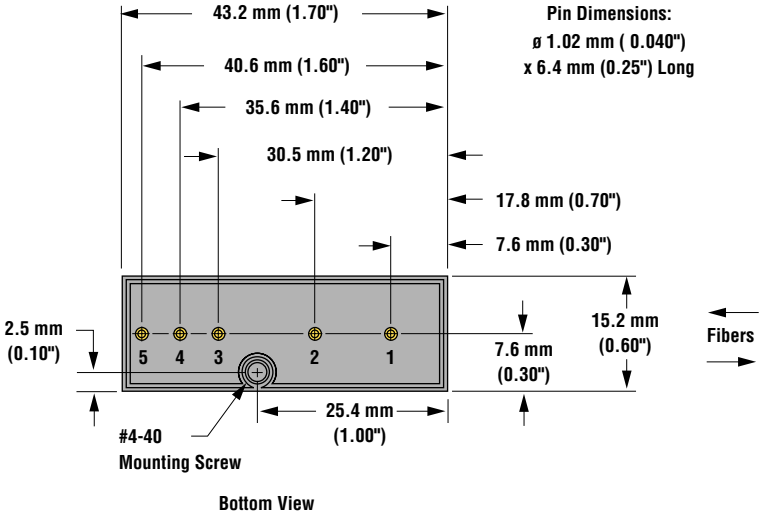
PC44 Series Modules Dimensions & Features



PC44 Series Modules Pin Identification



PC44 Series Modules Dimensions & Pin Locations

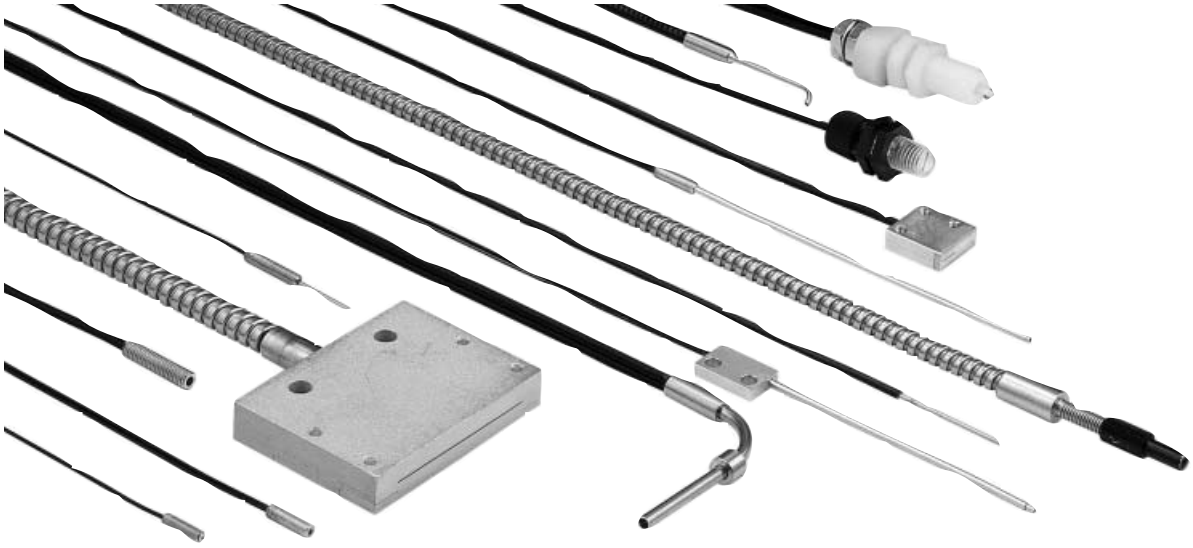


PC44 Accessories

Printed Circuit Board Pin Socket

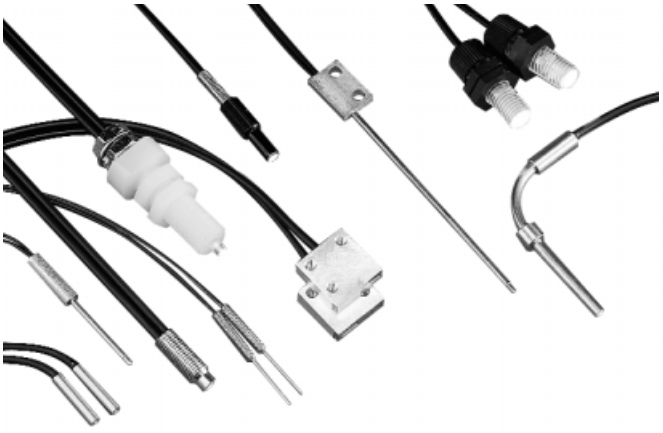
PC44 modules may be soldered directly to a printed circuit board (wave solder or hand solder). A set of socket pins is available for PC board mounting. PC44 modules plug into standard I/O mounting racks.

Model	Description
PCJ-25	Socket pin kit contains 25 socket pins (5 required per module) and 5 hold-down nuts (1 required per module)



Fiber Optics

Plastic Fiber Optics



- Banner plastic fiber optics are an economical alternative to glass fiber optics for piping photoelectric sensing light into and out of confined areas where environmental conditions allow
- Plastic fiber optics are ideal for applications involving small-sized object detection or repeated fiber flexing and bending
- They are available in individual or bifurcated styles:
  - Individual fibers are used in pairs in the opposed sensing mode; all individual plastic fiber optics are sold in pairs
  - Bifurcated fibers are two-way fibers having a single sensing end that both emits and receives light and dual control sensor ends which attach separately to the sensor
- DURA-BEND™ fibers were developed to provide improved flexibility when integrating ø 1.0 mm (0.040") plastic fiber optic assemblies into difficult-to-access locations. Standard 1.0 mm plastic fiber optic assemblies are limited to a minimum bend radius of 25 mm, at which point significant light attenuation (loss of light) occurs. The minimum bend radius for DURA-BEND optical fibers is reduced to 1 mm, with no loss of performance. DURA-BEND optical fiber cable is comprised of hundreds of tiny individual plastic optical fibers, fused to form an "effective" optical fiber core of 1.0 mm or 0.5 mm (also available).
- Banner plastic fiber optic assemblies are available in the following core diameters: 0.25 mm (0.010"), 0.50 mm (0.020"), 0.75 mm (0.030"), 1.0 mm (0.40") and 1.5 mm (0.060")

APPLICATION NOTES and WARNINGS

1. Plastic fiber assemblies having the letter "U" in the suffix of their model numbers, have unterminated control ends (the end that is coupled to the photoelectric sensor). These fiber optic assemblies may be cut by the customer to the required length using the supplied cutter. Use only the supplied cutter to ensure optimal light coupling efficiency.
2. Terminated plastic fiber assemblies are optically ground and polished, and cannot be shortened, spliced, or otherwise modified.
3. Do not subject the plastic fibers to sharp bends, pinching, high tensile loads, or high levels of radiation.
4. When ordering fiber lengths in excess of 2 m (6'), take into account light signal attenuation due to the additional length.
5. Due to their light transmission properties, plastic fiber optics are recommended for use only with visible light fiber optic sensors.
6. Use caution when applying fiber optics in hazardous locations. Although fiber optic assemblies are, by themselves, intrinsically safe, the sensor and associated electronics must be LOCATED IN A SAFE ENVIRONMENT. Alternatively, fiber optics may be used with sensor model SMI912FPQD (page 359). This sensor is approved for use inside hazardous areas when used with an appropriate intrinsic barrier. Also, see NAMUR sensor models Q45AD9FP (page 417). Fiber optics do not necessarily provide a hermetic seal between a hazardous environment and the safe environment.

Model Numbering Scheme for Plastic Fiber Optic Assemblies

P B P 4 6 U C X

PLASTIC FIBER FAMILY designator

Same for all plastic fibers

STYLE designator

B = Bifurcated fiber
I = Individual fiber*

MODIFICATIONS designator

"MXX" = Sensing end tip modification

CONTROL END designator
(describes end of fiber which attaches to the sensor)

T = Terminated straight cable (D11, D12)
TS = Terminated Stainless sheath ((D11, D12)
TP = Terminated PVC sheath ((D11, D12)
TT = Terminated Teflon® sheath ((D11, D12)
T1 = Terminated straight cable (Q45, OMNI-BEAM)
TS1 = Terminated Stainless sheath (Q45, OMNI-BEAM)
TP1 = Terminated PVC sheath (Q45, OMNI-BEAM)
TT1 = Terminated Teflon® sheath (Q45, OMNI-BEAM)
U = Unterminated straight cable**
UC = Unterminated Coiled cable
UHF = Unterminated DURA-BEND™ ("High Flex") cable

SENSING END designator

A = Angled
AT = Angled Threaded
AF = Angled Ferrule
AP = Angled Probe
CF = Coaxial Ferrule
CT = Coaxial Threaded
EFP = Extended Ferrule Probe
F = Ferrule
FM = Ferruled Miniature
FMP = Ferrule Miniature Probe
FP = Ferrule Probe
L = Lensed
P = Probe
PF = Probe Ferrule
PM = Probe Miniature
PMSB = Probe Miniature Side view Bendable
PS = Probe Side view
PSB = Probe Side view Bendable
PSM = Probe Side view Miniature
R = Rectangular
RS = Rectangular Side view
T = Threaded
TA = Threaded Angle
TF = Threaded Ferrule
TP = Threaded Probe
TR = Threaded Rectangular
U = Unterminated

FIBER LENGTH designator

3 = 1 m (3')
6 = 2 m (6')
15 = 5 m (15')

CORE FIBER DIAMETER designator

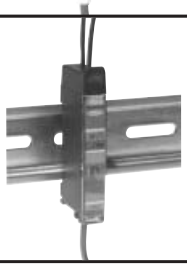
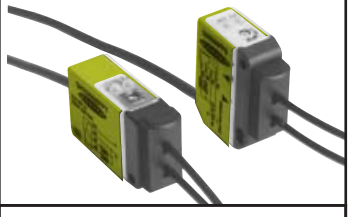
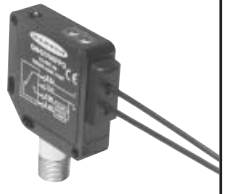
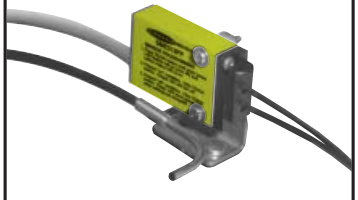
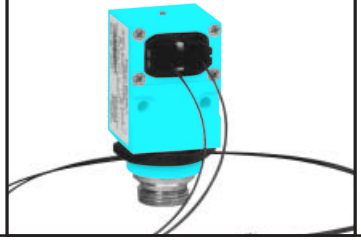
1 = 0.25 mm (0.01")
1X4 = 0.25 mm (0.01") x 4
1X8 = 0.25 mm (0.01") x 8
1X16 = 0.25 mm (0.01") x 16
1X32 = 0.25 mm (0.01") x 32
2 = 0.50 mm (0.02")
3 = 0.75 mm (0.03")
4 = 1.00 mm (0.04")
6 = 1.50 mm (0.06")

* Individual plastic fibers are sold in pairs.

** Plastic fibers having the letter "U" in the suffix of their model numbers have unterminated control ends, and may be cut by the customer to the required length. Use cutters supplied with fiberoptic cable.

The following Banner fiber optic products use plastic fibers for sensing applications.

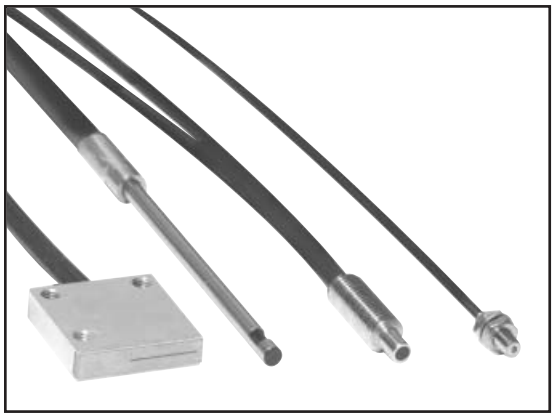
Sensors for Plastic Fiber Optics Quick Reference Guide

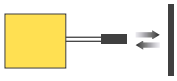
D10 Series Plastic Fiber Optic Models (pp. 596 & 598)		**OMNI-BEAM** Plastic Fiber Optic Models (pp. 434 & 446)	
D11 Series Plastic Fiber Optic Models (pp. 604, 605, 610 & 611)		**PC44 Sensors** Plastic Fiber Optic Models (p. 636)	
D12 Series Plastic Fiber Optic Models (pp. 619, 624, 625 & 631)		**Q23** Plastic Fiber Optic Models (p. 99)	
ECONO-BEAM Plastic Fiber Optic Models (p. 163)		**Q45 & Q45X Series** Plastic Fiber Optic Models (pp. 386, 403 & 417)	
MAXI-BEAM Plastic Fiber Optic Models (p. 463)		**QM42 Series** Plastic Fiber Optic Models (p. 244)	
MINI-BEAM Plastic Fiber Optic Models (pp. 122, 132, 133 & 142)		**R55F** Plastic Fiber Optic Models (p. 307)	
VALU-BEAM Plastic Fiber Optic Models (pp. 343, 351 & 359)		**WORLD-BEAM™** Plastic Fiber Optic Models (p. 109)	

Plastic Fiber Optics Specifications

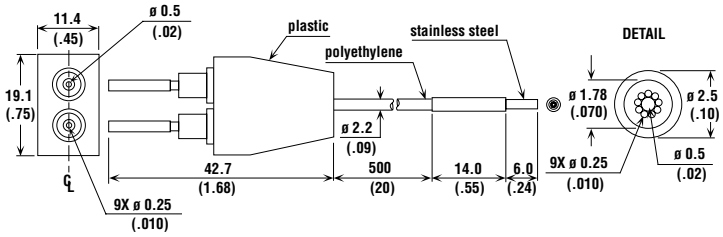
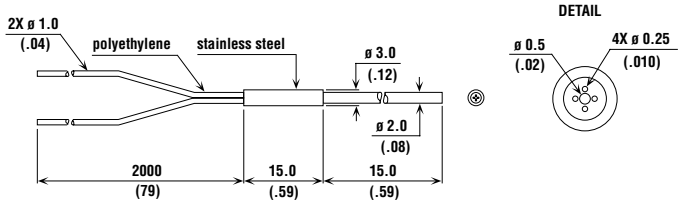
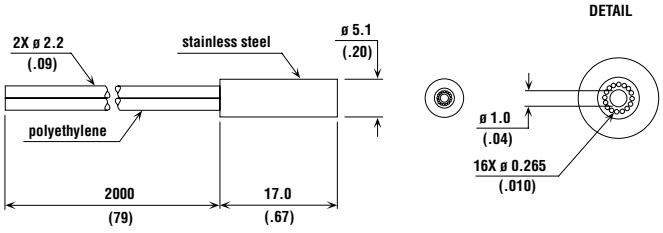
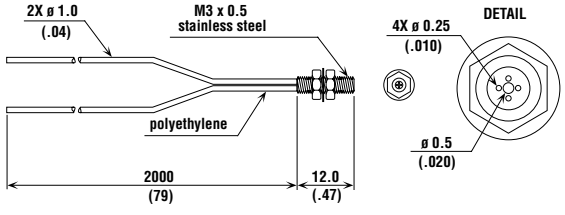
Construction	Optical Fiber: acrylic monofilament Protective Jacket: black polyethylene, except as noted Threaded End Tips and Hardware: nickel-plated brass Probe End Tips: annealed (bendable) T304 stainless steel Angled End tips: hardened T304 stainless steel Ferruled End Tips: T303 stainless steel
Sensing Range	Refer to the excess gain curves for the fiber optic sensor to be used.
Implied Dimensional Tolerance	All dimensions are in millimeters: x = ±2.5 mm (0.1"), x.x = ±0.25 mm (0.01") and x.xx = ±0.12 mm (0.005"), unless specified. "L" = ±40 mm per meter
Minimum Bend Radius	8 mm (0.3") for 0.25 mm (0.010") diameter fibers 12 mm (0.5") for 0.5 mm (0.020") diameter fibers (except DURA-BEND™) 25 mm (1.0") for 1.0 mm (0.040") diameter fibers (except DURA-BEND™) 38 mm (1.5") for 1.5 mm (0.060") diameter fibers
Repeat Bending/Flexing	Life expectancy of plastic fiber optic cable is in excess of one million cycles at bend radii of no less than the minimum and a bend of 90° or less. Avoid stress at the point where the cable enters the sensor ("control end") and at the sensing end tip. Coiled plastic fiberoptic assemblies are recommended for any application requiring reciprocating fiber motion.
Chemical Resistance	The acrylic core of the monofilament optical fiber will be damaged by contact with acids, strong bases (alkalis) and solvents. The polyethylene jacket will protect the fiber from most chemical environments. However, materials may migrate through the jacket with long term exposure. Samples of fiber optic material are available from Banner for testing and evaluation.
Temperature Extremes	Temperatures below -30°C will cause embrittlement of the plastic materials but will not cause transmission loss. Temperatures above +70°C will cause both transmission loss and fiber shrinkage.
Operating Temperature	-30° to +70°C (-20° to +158°F), unless otherwise specified

Diffuse Mode Plastic Fibers

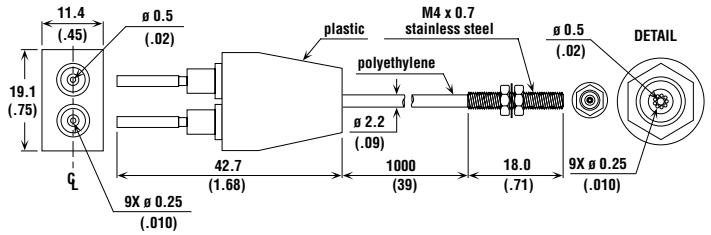
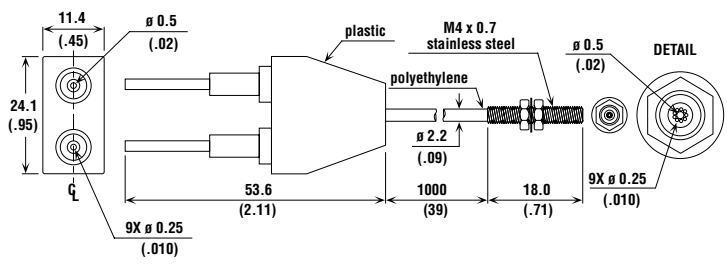
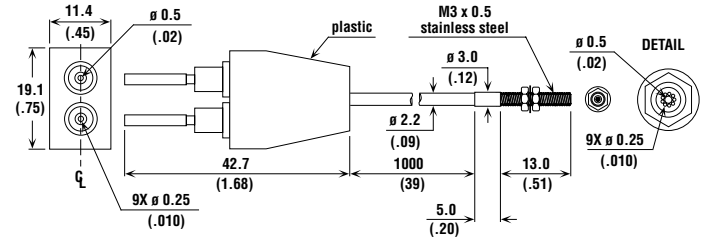
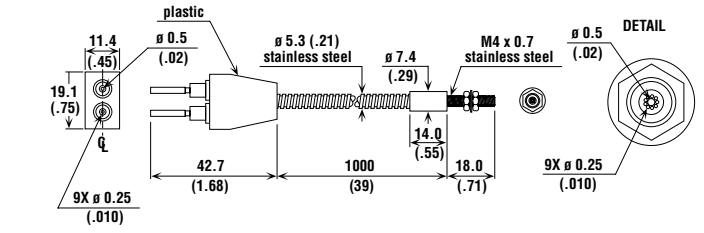
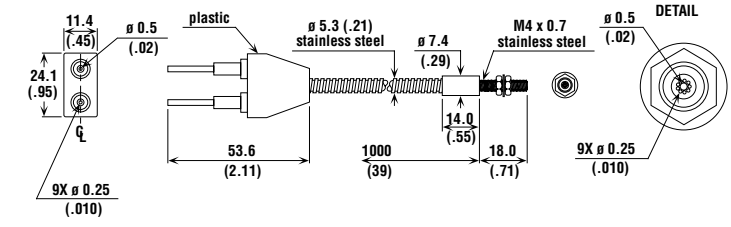
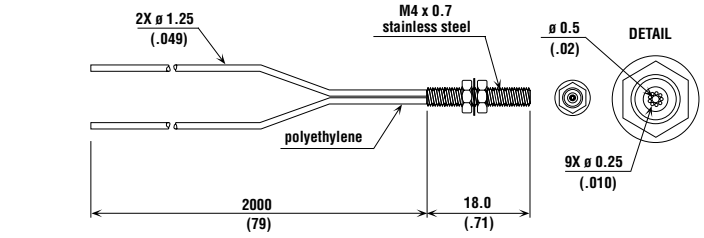




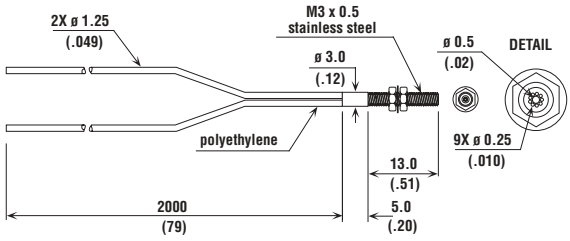
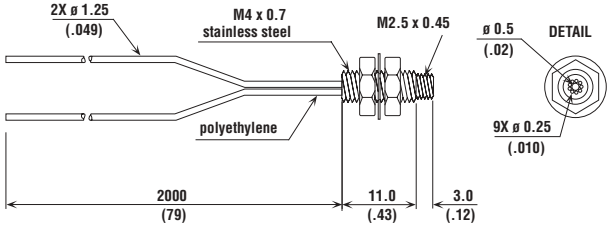
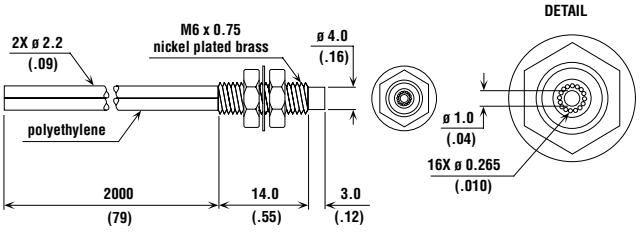
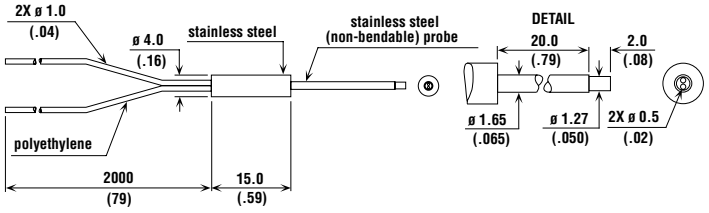
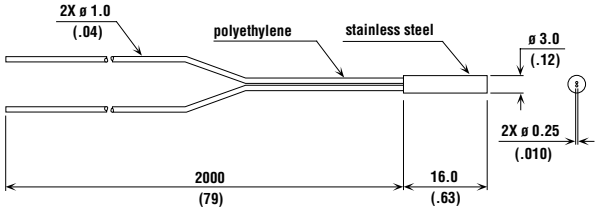
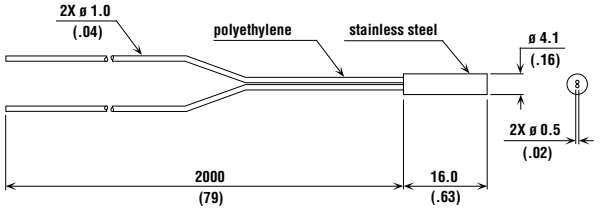
- Bifurcated fiber optic assemblies combine emitted and received light into a common sensing end tip
- Bifurcated fiber optic assemblies are used in the (divergent) diffuse sensing mode
- Coaxial types which include an M4 x 0.7 threaded sensing tip may be used in the convergent sensing mode with addition of model L4C6 lens (see page 673)
- Model numbers with “U” suffix are cut-to-length assemblies (use only the supplied cutter)
- Model numbers with “T” suffix indicate terminated assemblies which are designed to fit those sensor models which are listed in the “Construction” column
- Model number with “HF” suffix indicate DURA-BEND™ high-flex fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBCF21.7T	Bifurcated Coaxial Ferruled	1 x 0.5 mm 9 x 0.25 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors Non-bendable ferrule end tip	
PBCF21X46U	Bifurcated Coaxial Ferruled	1 x 0.5 mm 4 x 0.25 mm	Cut to length cable Non-bendable ferrule end tip	
PBCF46U	Bifurcated Coaxial Ferruled	1 x 1.0 mm 16 x 0.265 mm	Cut to length cable, smooth ferrule end tip	
PBCT21X46U	Bifurcated Coaxial Threaded	1 x 0.5 mm 4 x 0.25 mm	Cut to length cable M3 threaded end tip	

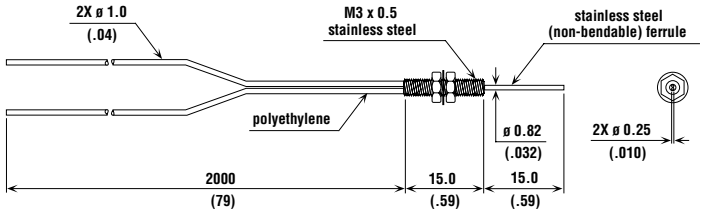
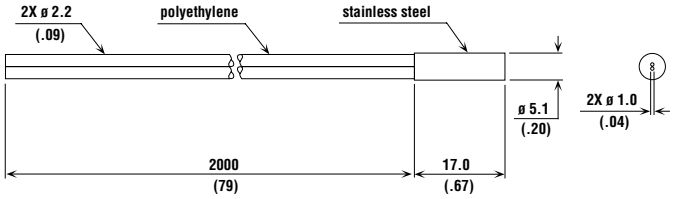
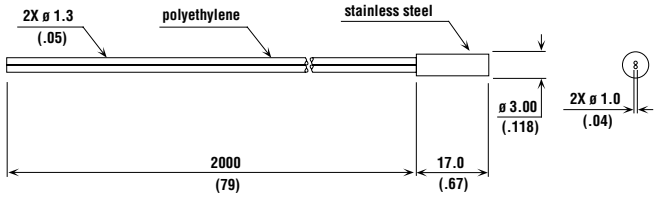
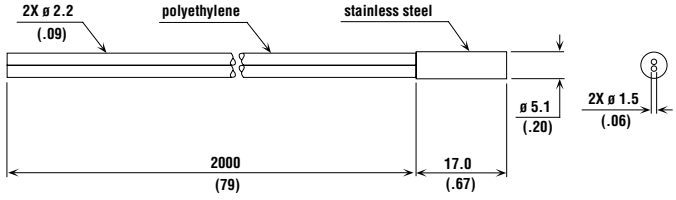
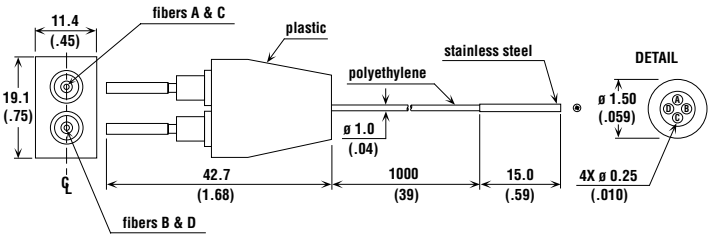
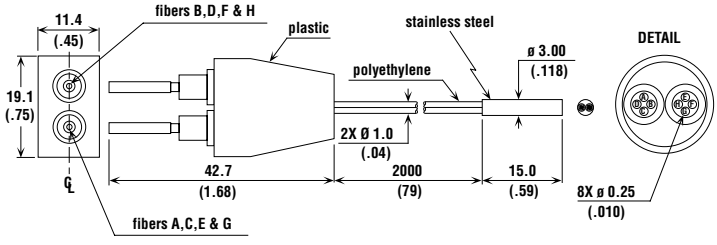
Diffuse Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBCT23T	Bifurcated Coaxial Threaded	1 x 0.5 mm 9 x 0.25 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors M4 threaded end tip, may be used w/L4C6 lens	
PBCT23T1	Bifurcated Coaxial Threaded	1 x 0.5 mm 9 x 0.25 mm	Terminated sensor end; use w/Q45, OMNI-BEAM, MAXI-BEAM, & VALU-BEAM plastic fiber sensors M4 threaded end tip, may be used w/L4C6 lens	
PBCT23TM3	Bifurcated Coaxial Threaded	1 x 0.5 mm 9 x 0.25 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors M3 threaded end tip	
PBCT23TS	Bifurcated Coaxial Threaded	1 x 0.5 mm 9 x 0.25 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors SS protective sheath, M4 threaded end tip, may be used w/L4C6	
PBCT23TS1	Bifurcated Coaxial Threaded	1 x 0.5 mm 9 x 0.25 mm	Terminated sensor end; use w/Q45, OMNI-BEAM, MAXI-BEAM, & VALU- BEAM plastic fiber sensors SS protective sheath, M4 threaded end tip, may be used w/L4C6 lens	
PBCT26U	Bifurcated Coaxial Threaded	1 x 0.5 mm 9 x 0.25 mm	Cut to length cable M4 threaded end tip, may be used with L4C6 lens	

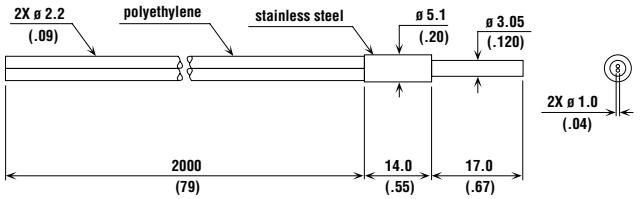
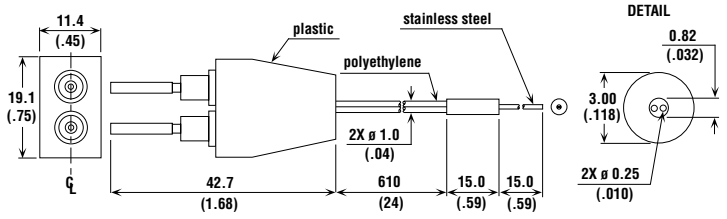
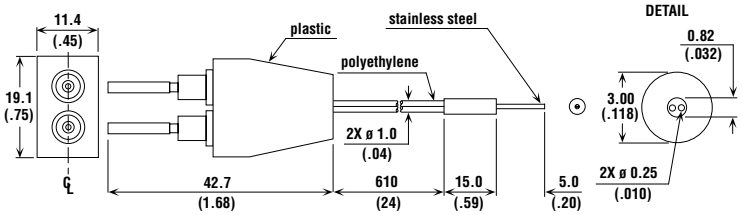
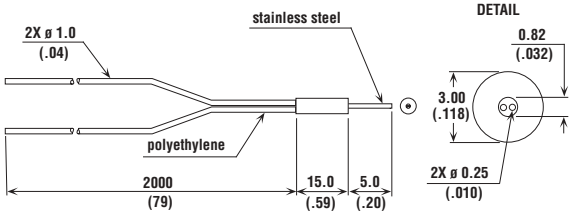
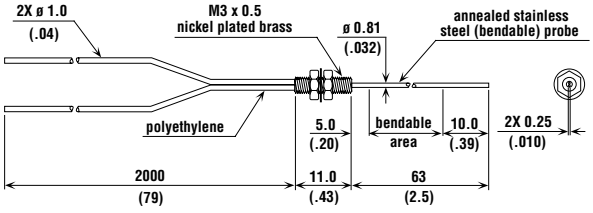
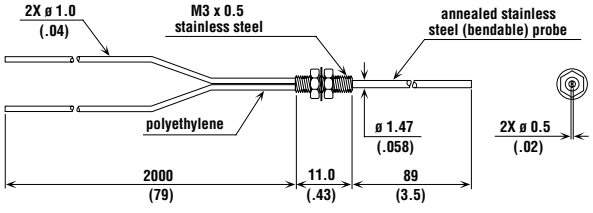
Diffuse Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
New! **PBCT26UM3**	Bifurcated Coaxial Threaded	1 x 0.5 mm 9 x 0.25 mm	Cut to length cable, M3 threaded end tip	
New! **PBCT26UM4M2.5**	Bifurcated Coaxial Threaded	1 x 0.5 mm 9 x 0.25 mm	Cut to length cable, M4 & M2.5 threaded end tip, may be used w/L2 lens	
PBCT46U	Bifurcated Coaxial Threaded	1 x 1.0 mm 16 x 0.265 mm	Cut to length cable, M6 threaded end tip	
PBEFP26U	Bifurcated Extended Ferrule Probe	0.5 mm	Cut to length cable, non-bendable ferrule & probe end tip	
PBF16U	Bifurcated Ferruled	0.25 mm	Cut to length cable, smooth ferrule end tip	
PBF26U	Bifurcated Ferruled	0.5 mm	Cut to length cable, smooth ferrule end tip	

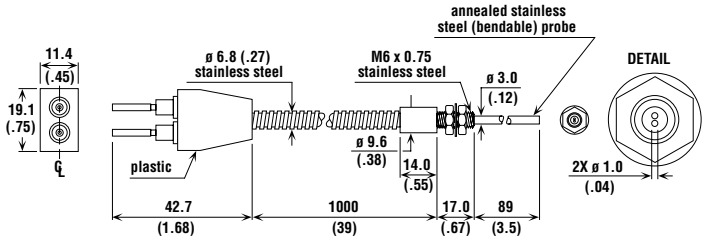
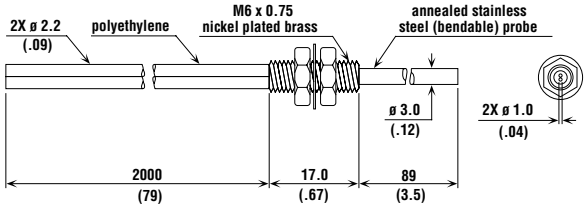
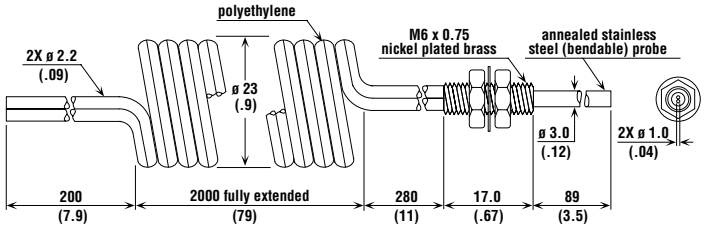
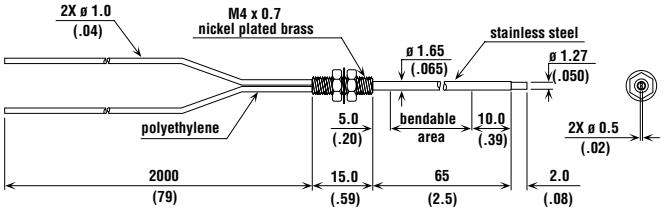
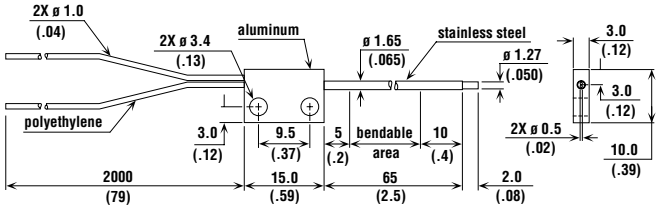
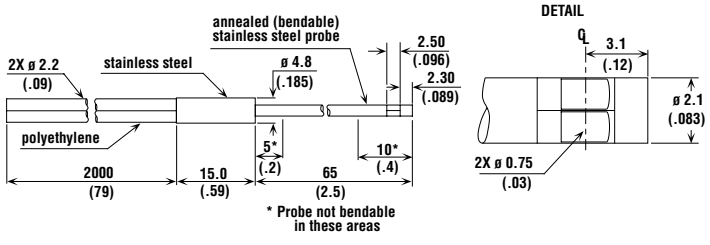
Diffuse Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBFM16U	Bifurcated Ferrule Miniature	0.25 mm	Cut to length cable, non-bendable ferrule end tip	
PBF46U **PBF46UHF**	Bifurcated Ferruled	1.0 mm	Cut to length cable, smooth ferrule end tip	
New! **PBF46UM3MJ1.3**	Bifurcated Ferruled	1.0 mm	Cut to length cable, smooth ferrule end tip	
PBF66U	Bifurcated Ferruled	1.5 mm	Cut to length cable, smooth ferrule end tip	
PBFM1X43T	Bifurcated Ferrule Miniature	4 x 0.25 mm	Terminated sensor end; use w/D11 & D12 series plastic fiber sensor Smooth ferrule end tip	
PBFM1X86T	Bifurcated Ferrule Miniature	8 x 0.25 mm	Terminated sensor end; use w/D11 & D12 series plastic fiber sensor Smooth ferrule end tip	

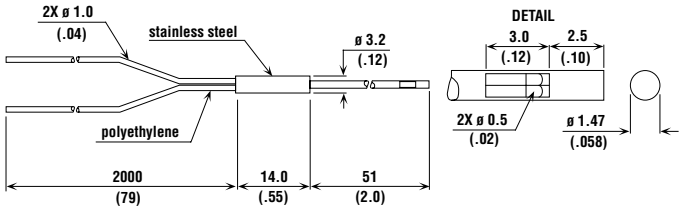
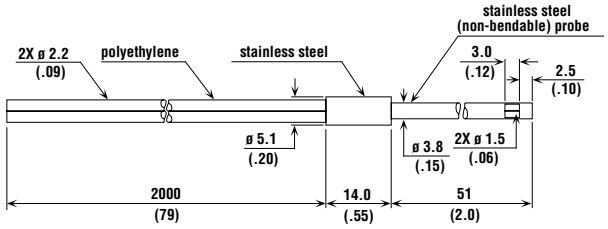
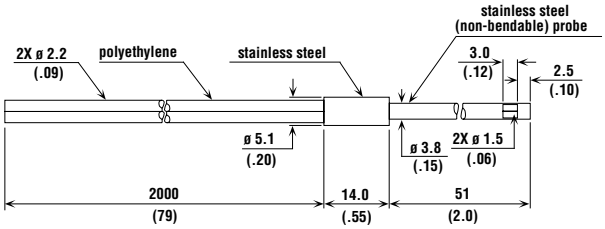
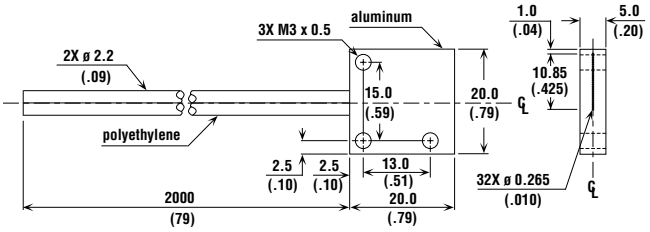
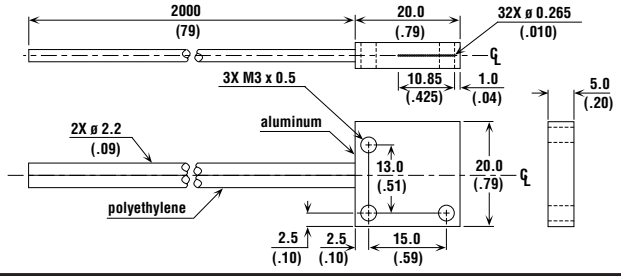
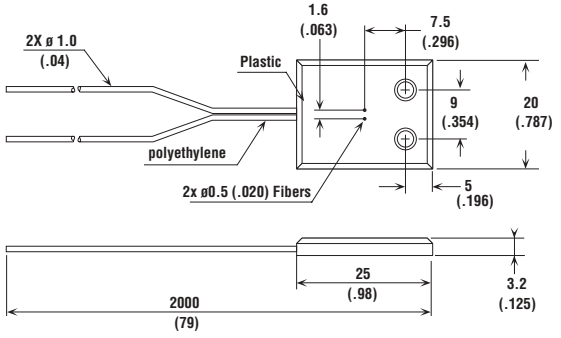
Diffuse Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBFM46U **PBFM46UHF**	Bifurcated Ferrule Miniature	1.0 mm	Cut to length cable, smooth ferrule end tip	
PBFMP12T	Bifurcated Ferrule Miniature Probe	0.25 mm	Terminated sensor end; use w/D11 & D12 series plastic fiber sensor Non-bendable probe end tip	
PBFMP12TMP.2	Bifurcated Ferrule Miniature Probe	0.25 mm	Terminated sensor end; use w/D11 & D12 series plastic fiber sensor Non-bendable probe end tip	
New! **PBFMP16UMP.2**	Bifurcated Ferrule Miniature Probe	0.25 mm	Cut to length cable, non-bendable probe end tip	
PBP16U	Bifurcated Probe	0.25 mm	Cut to length cable, bendable probe end tip	
PBP26U	Bifurcated Probe	0.5 mm	Cut to length cable, bendable probe end tip	

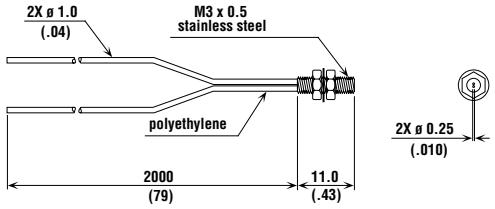
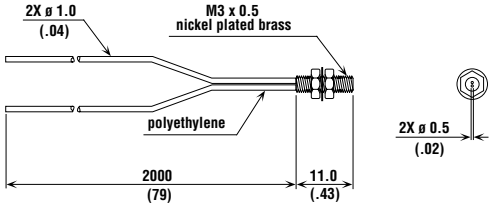
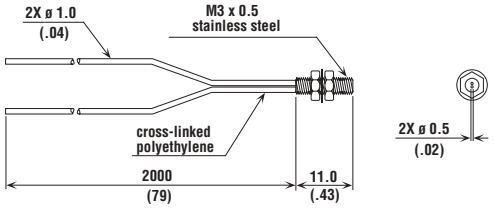
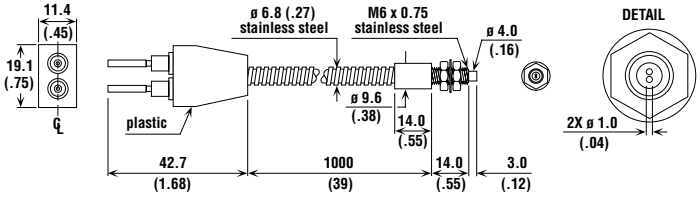
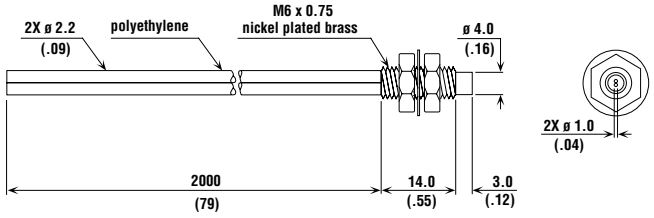
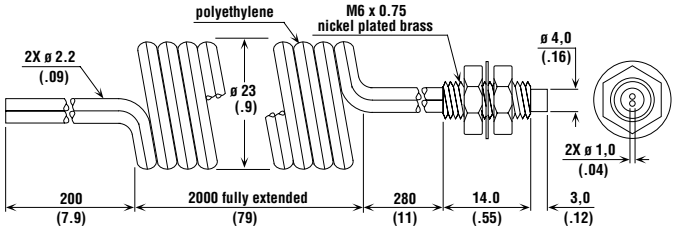
Diffuse Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBP43TS	Bifurcated Probe	1.0 mm	Terminated sensor end; use w/D11 & D12 series plastic fiber sensor SS protective sheath, bendable probe end tip	
PBP46U **PBP46UHF**	Bifurcated Probe	1.0 mm	Cut to length cable, bendable probe end tip	
PBP46UC	Bifurcated Probe	1.0 mm, coiled cable	Cut to length cable (straight fiber section only), bendable probe end tip	
PBPF26U	Bifurcated Probe Ferrule	0.5 mm	Cut to length cable, bendable probe ferrule end tip	
PBPF26UMB	Bifurcated Probe Ferrule	0.5 mm	Cut to length, thin profile mounting block, bendable probe ferrule end tip	
PBPMSB36U	Bifurcated Probe Miniature Side View Bendable	0.75 mm	Cut to to length cable, bendable side view probe end tip	

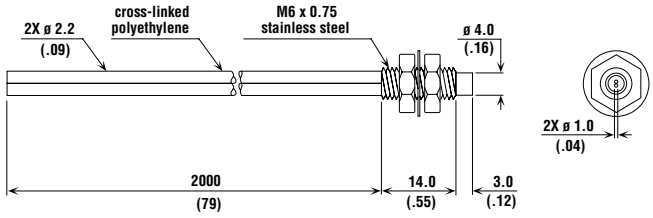
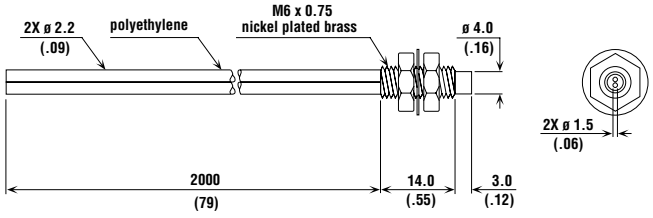
Diffuse Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBPS26U	Bifurcated Probe Side View	0.5 mm	Cut to length cable, non-bendable side view probe end tip	
PBPS46U **PBPS46UHF**	Bifurcated Probe Side View	1.0 mm	Cut to length cable, non-bendable side view probe end tip	
PBPS66U	Bifurcated Probe Side View	1.5 mm	Cut to length cable, non-bendable side view probe end tip	
PBR1X326U	Bifurcated Rectan-gular End View	32 x 0.265 mm	Cut to length cable, fiber array exits from end of aluminum housing	
PBRS1X326U	Bifurcated Rectan-gular Side View	32 x 0.265 mm	Cut to length cable, fiber array exits from side of aluminum housing	
PBRS26U	Bifurcated Rectan-gular	0.5 mm	Cut to length cable, low-profile "flat pack" end tip	

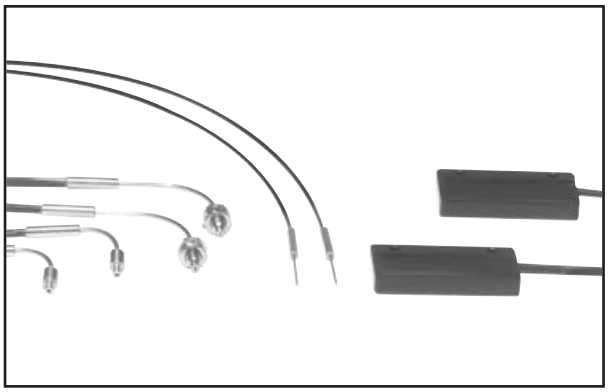
Diffuse Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBT16U	Bifurcated Threaded	0.25 mm	Cut to length cable, M3 threaded end tip	
PBT26U **PBT26UHF**	Bifurcated Threaded	0.5 mm	Cut to length cable, M3 threaded end tip	
PBT26UHT1	Bifurcated Threaded	0.5 mm	Cut to length 125°C (257°F) high temperature cable, M3 threaded end tip	
PBT43TS	Bifurcated Threaded	1.0 mm	Terminated sensor end; use w/D11 & D12 series plastic fiber sensor SS protective sheath, M6 threaded end tip	
PBT46U **PBT46UHF**	Bifurcated Threaded	1.0 mm	Cut to length cable, M6 threaded end tip	
PBT46UC	Bifurcated Threaded	1.0 mm, coiled cable	Cut to length cable (straight fiber section only) , M6 threaded end tip	

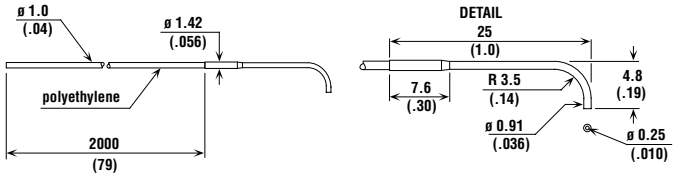
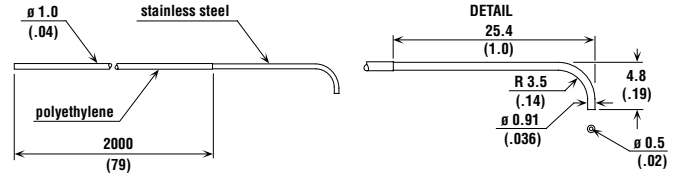
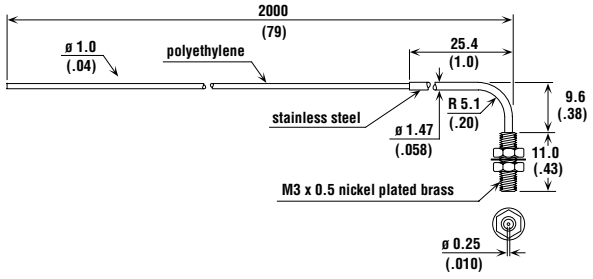
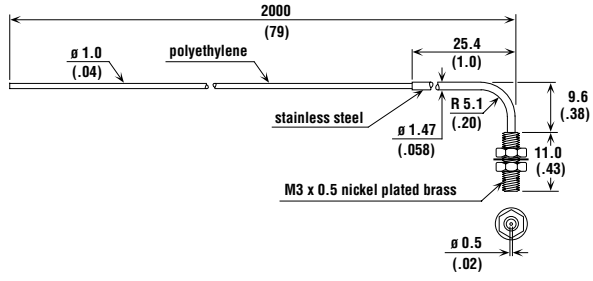
Diffuse Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBT46UHT1	Bifurcated Threaded	1.0 mm	Cut to length 125°C (257°F) high temperature cable, M6 threaded end tip	
PBT66U	Bifurcated Threaded	1.5 mm	Cut to length cable, M6 threaded end tip	

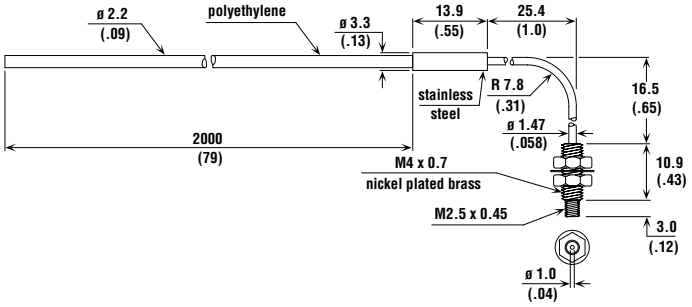
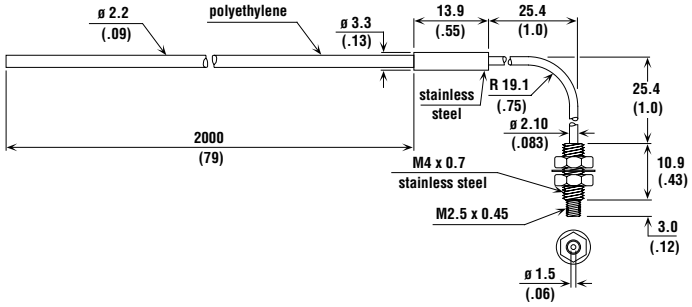
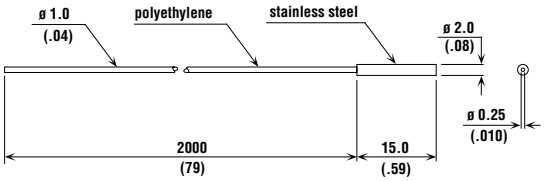
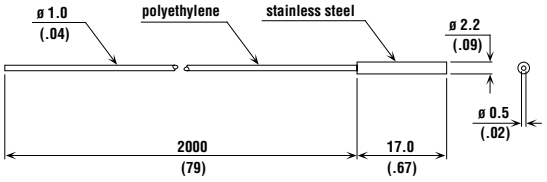
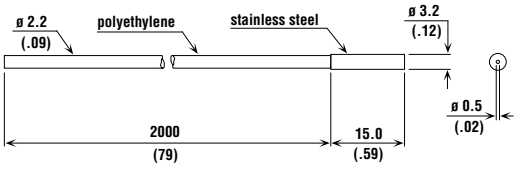
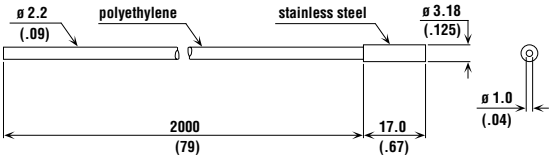
Opposed Mode Plastic Fibers



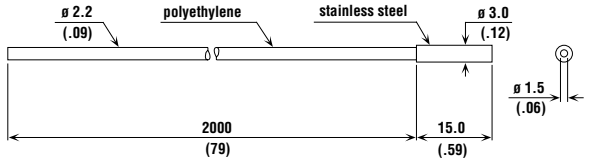
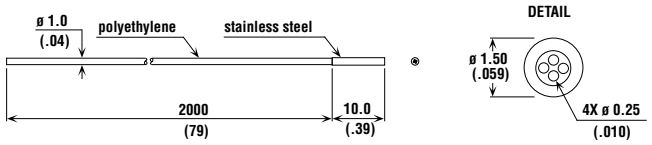
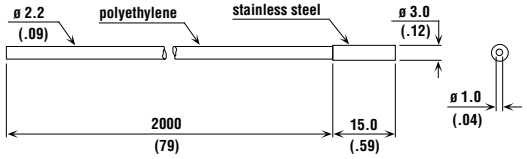
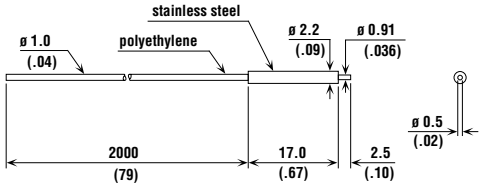
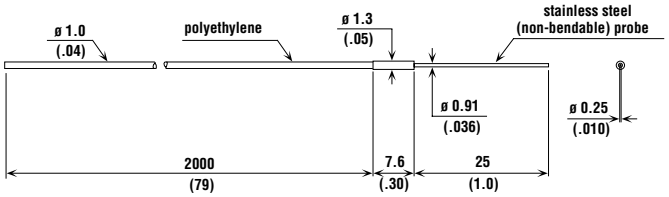
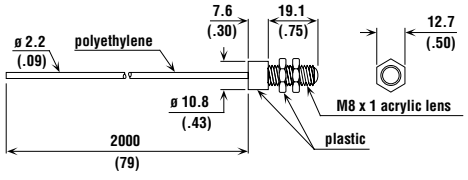
- Individual fiber optic assemblies are sold in pairs, and are usually used in the opposed mode
- Models which include an M2.5 x 0.45 threaded sensing tip may be used with optional lenses (see page 673)
- Model numbers with “U” suffix are cut-to-length assemblies (use only the supplied cutter)
- Model number with “T” suffix indicate terminated assemblies which are designed to fit those sensor models which are listed in the “Construction” column
- Model number with “HF” suffix indicate DURA-BEND™ high-flex fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIA16U	Individual Angled	0.25 mm	Cut to length cable, non-bendable end tip	
PIA26U	Individual Angled	0.5 mm	Cut to length cable, non-bendable end tip	
PIAT16U	Individual Angled Threaded	0.25 mm	Cut to length cable, M3 threaded end tip	
PIAT26U	Individual Angled Threaded	0.5 mm	Cut to length cable, M3 threaded end tip	

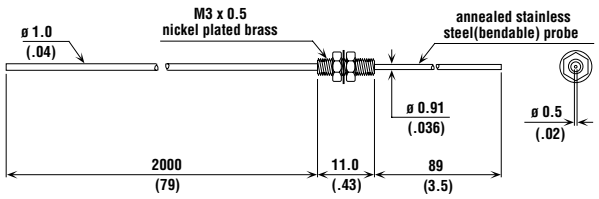
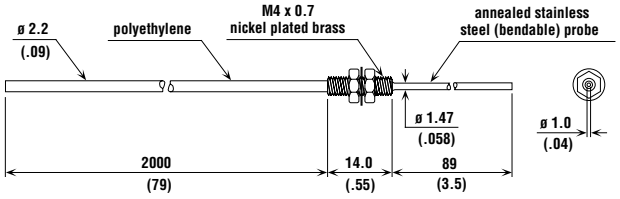
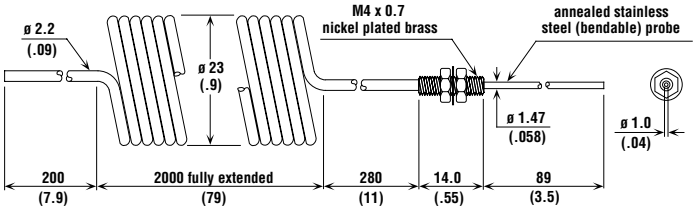
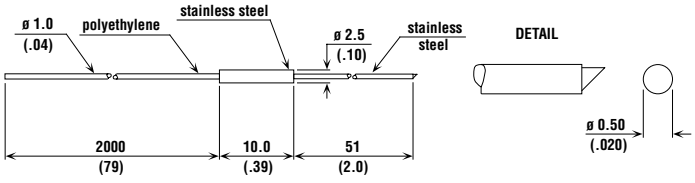
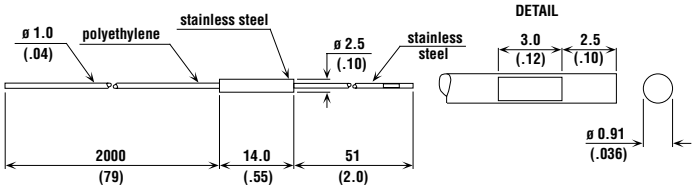
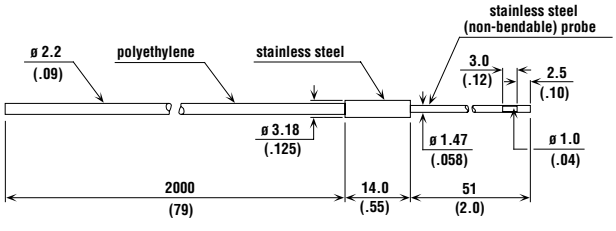
Opposed Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIAT46U **PIAT46UHF**	Individual Angled Threaded	1.0 mm	Cut to length cable, M4 & M2.5 threaded end tip, may be used w/L2 & L2RA lens	
PIAT66U	Individual Angled Threaded	1.5 mm	Cut to length cable, M4 & M2.5 threaded end tip, may be used w/L2 & L2RA lens	
PIF16U	Individual Ferrule	0.25 mm	Cut to length cable, smooth ferrule end tip	
PIF26U	Individual Ferrule	0.5 mm	Cut to length cable, smooth ferrule end tip	
PIF26UMLS	Individual Ferrule	0.5 mm	Cut to length cable, smooth ferrule end tip	
PIF46U **PIF46UHF**	Individual Ferrule	1.0 mm	Cut to length cable, smooth ferrule end tip	

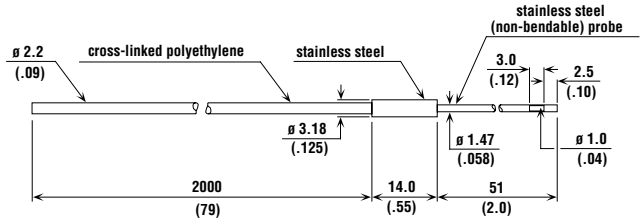
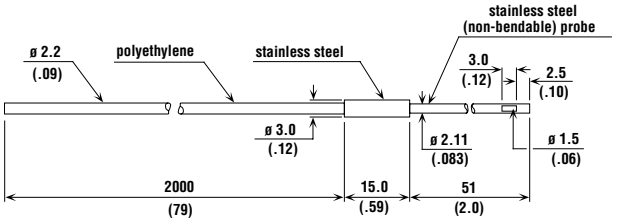
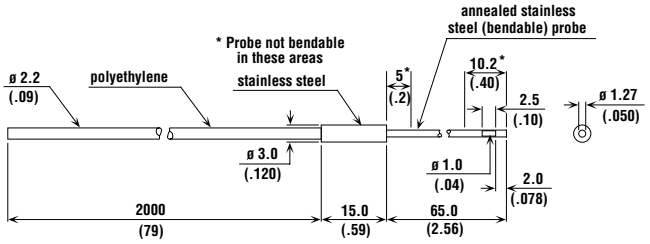
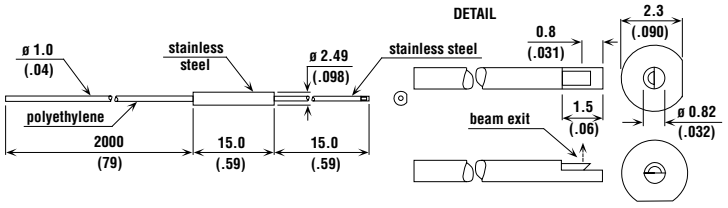
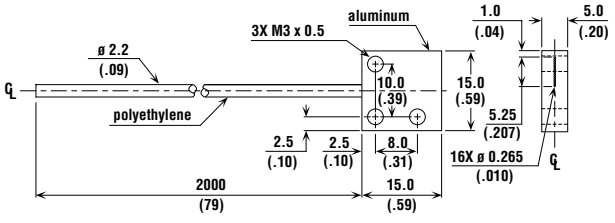
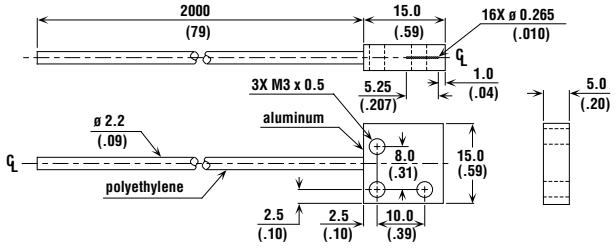
Opposed Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIF66U	Individual Ferrule	1.5 mm	Cut to length cable, smooth ferrule end tip	
PIFM1X46U	Individual Ferrule Miniature	4 x 0.25 mm	Cut to length cable, smooth ferrule end tip	
PIFM46U **PIFM46UHF**	Individual Ferrule Miniature	1.0 mm	Cut to length cable, smooth ferrule end tip	
PIFP26U	Individual Ferrule Probe	0.5 mm	Cut to length cable, ferrule probe end tip	
PIP16U	Individual Probe	0.25 mm	Cut to length cable, non-bendable probe end tip	
PIL46U **PIL46UHF**	Individual Lensed	1.0 mm	Cut to length cable, 8 mm lens	

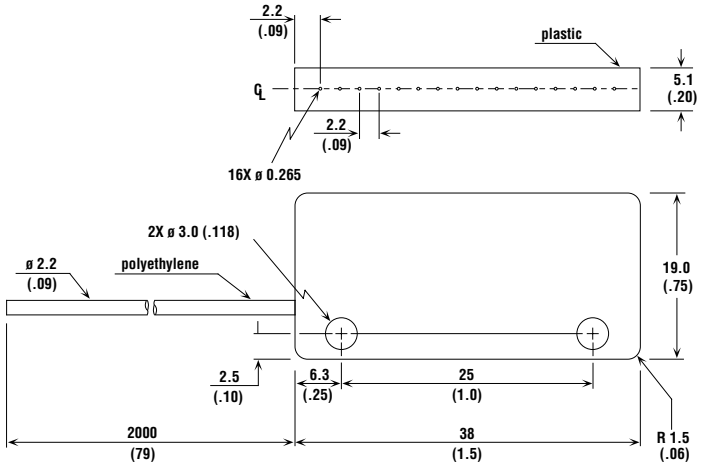
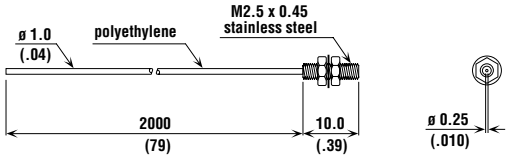
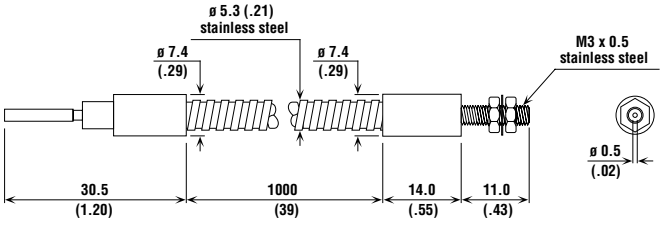
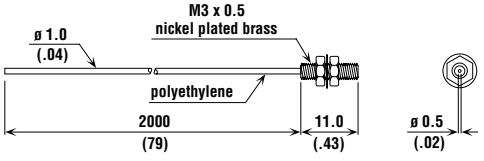
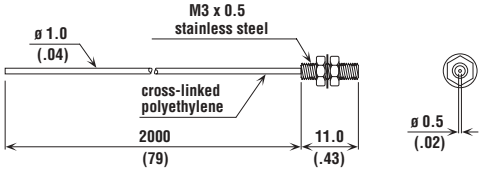
Opposed Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIP26U	Individual Probe	0.5 mm	Cut to length cable, bendable probe end tip	
PIP46U **PIP46UHF**	Individual Probe	1.0 mm	Cut to length cable, bendable probe end tip	
PIP46UC	Individual Probe, Coiled Cable	1.0 mm	Cut to length cable (straight fiber section only), bendable probe end tip	
PIPS16U	Individual Probe Side View	0.25 mm	Cut to length cable, side view non-bendable probe end tip	
PIPS26U	Individual Probe Side View	0.5 mm	Cut to length cable, side view non-bendable probe end tip	
PIPS46U **PIPS46UHF**	Individual Probe Side View	1.0 mm	Cut to length cable, side view non-bendable probe end tip	

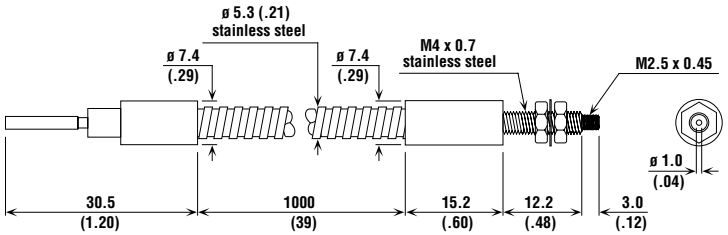
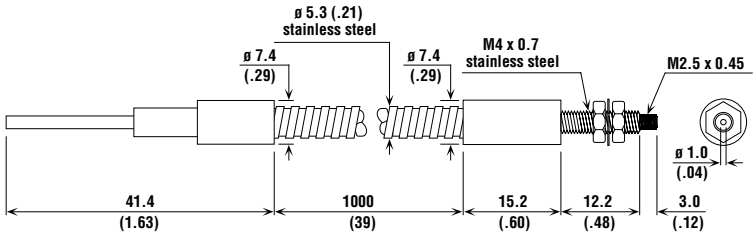
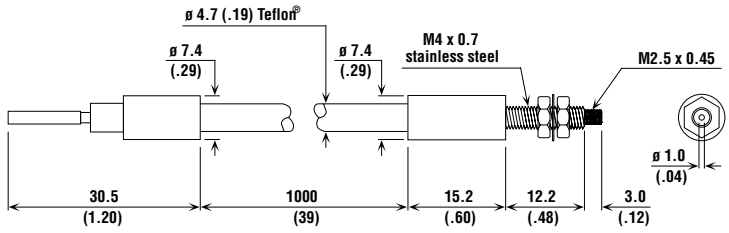
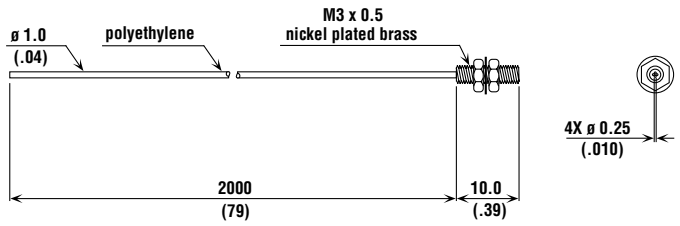
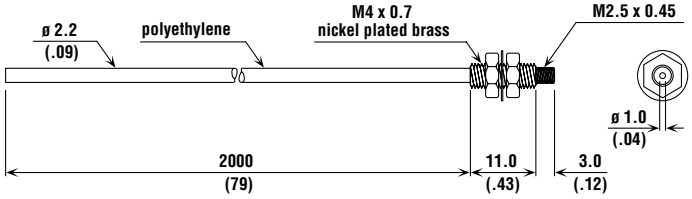
Opposed Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIPS46UHT1	Individual Probe Side View	1.0 mm	Cut to length 125°C (257°F) high temperature cable, side view non-bendable probe end tip	
PIPS66U	Individual Probe Side View	1.5 mm	Cut to length cable, side view non-bendable probe end tip	
PIPSB46U **PIPSB46UHF**	Individual Probe Side View Bendable	1.0 mm	Cut to length cable, side view bendable probe end tip	
PIPSM26U	Individual Probe Side View Miniature	0.5 mm	Cut to length cable, side view non-bendable probe end tip	
PIR1X166U	Individual Rectan-gular	16 x 0.265 mm	Cut to length cable, fiber array exits from end of aluminum housing	
PIRS1X166U	Individual Rectan-gular Side Exit	16 x 0.265 mm	Cut to length cable, fiber array exits from side of aluminum housing	

Opposed Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIRS1X166UMPMAL	Individual Rectangular Side Exit	16 x 0.265 mm	Cut to length cable, fiber array exits from side of plastic housing	
PIT16U	Individual Threaded	0.25 mm	Cut to length cable, M2.5 threaded end tip	
PIT23TS	Individual Threaded	0.5 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors SS protective sheathing, M3 threaded end tip	
New! PIT26U PIT26UHF	Individual Threaded	0.5 mm	Cut to length cable, M3 threaded end tip	
New! PIT26UHT1	Individual Threaded	0.5 mm	Cut to length 125°C (257°F) high temperature cable, M3 threaded end tip	

Opposed Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIT43TS	Individual Threaded	1.0 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors SS protective sheath, M4 & M2.5 threaded end tip, may be used w/L2 & L2RA Lens	
PIT43TS1	Individual Threaded	1.0 mm	Terminated sensor end; use w/Q45, OMNI-BEAM, MAXI-BEAM, & VALU-BEAM plastic fiber sensors SS protective sheath, M4 & M2.5 threaded end tip, may be used w/L2 & L2RA Lens	
PIT43TT	Individual Threaded	1.0 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors Teflon® protective sheath, M4 & M2.5 threaded end tip, may be used w/L2 & L2RA Lens	
PIT1X46U	Individual Threaded	4 x 0.25 mm	Cut to length cable, M3 threaded end tip	
PIT46U **PIT46UHF**	Individual Threaded	1.0 mm	Cut to length cable, M4 & M2.5 threaded end tip, may be used w/L2 and L2RA lens	

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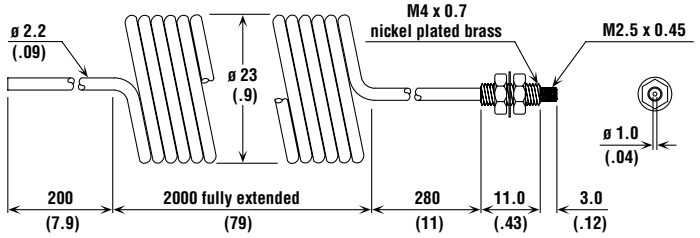
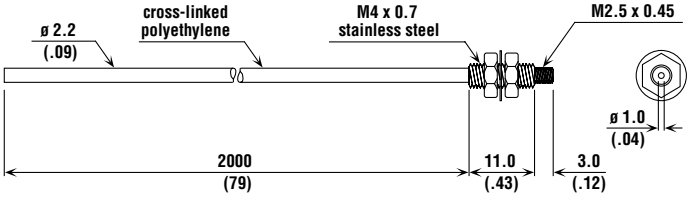
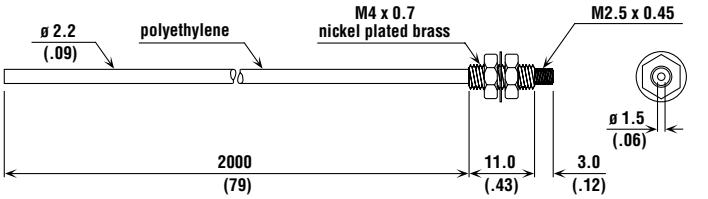
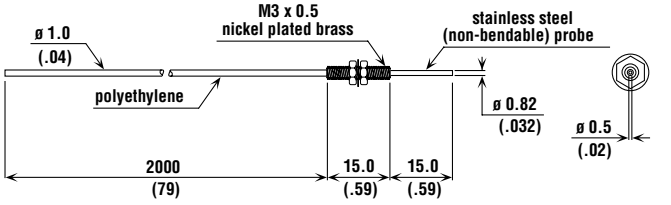
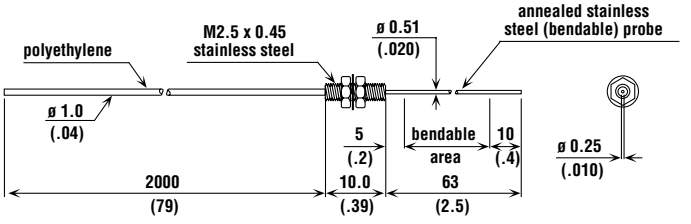
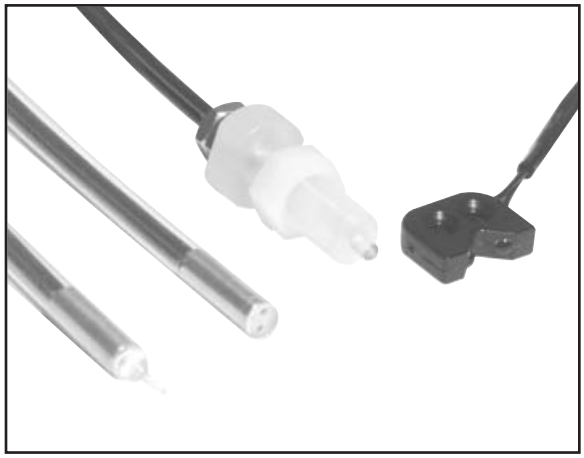
Opposed Mode Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIT46UC	Individual Threaded	1.0 mm, coiled cable	Cut to length cable (straight fiber section only), M4 & M2.5 threaded end tip, may be used w/L2 and L2RA lens	
PIT46UHT1	Individual Threaded	1.0 mm	Cut to length 125°C (257°F) high temperature cable, M4 & M2.5 threaded end tip, may be used w/L2 & L2RA lens	
PIT66U	Individual Threaded	1.5 mm	Cut to length cable, M4 & M2.5 threaded end tip, may be used w/L2 & L2RA lens	
PITF26U	Individual Threaded Ferrule	0.5 mm	Cut to length cable, non-bendable ferrule end tip	
PITP16U	Individual Threaded Probe	0.25 mm	Cut to length cable, bendable probe end tip	

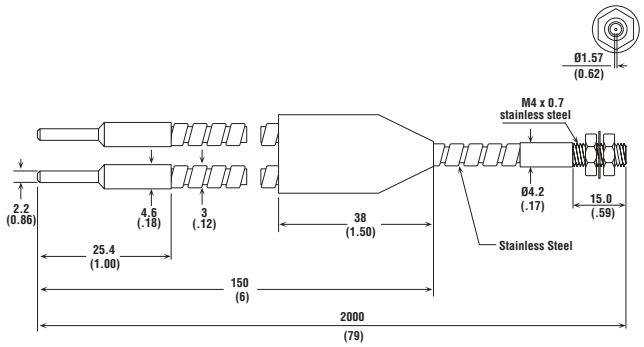
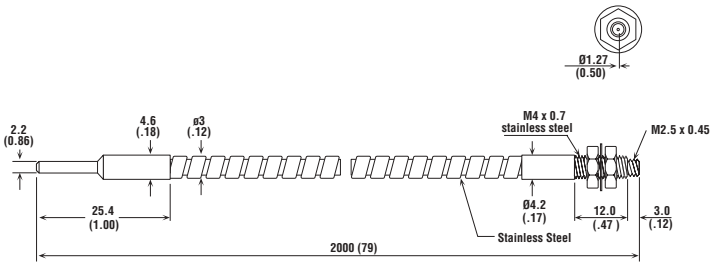
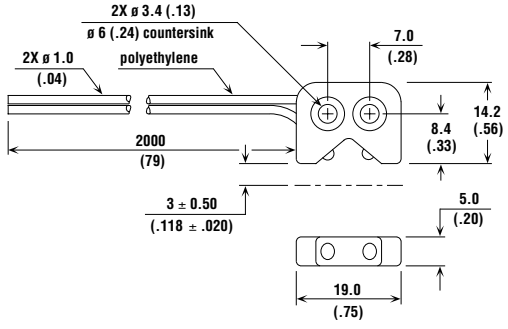
Special Application Plastic Fibers



The following plastic fiber optic assemblies have been developed to solve popular special sensing applications. They are considered to be standard fiber assemblies, which are available from stock. They include:

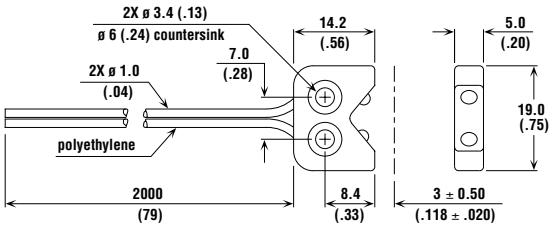
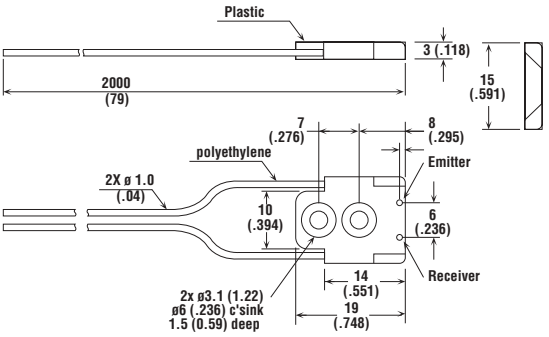
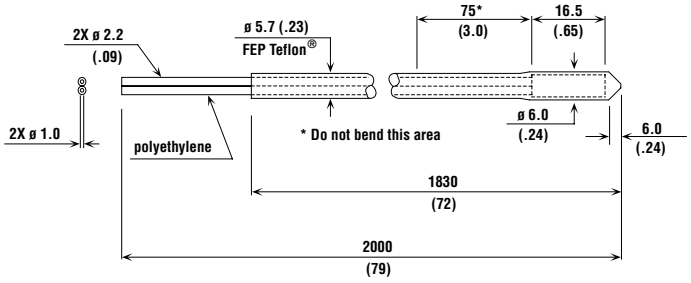
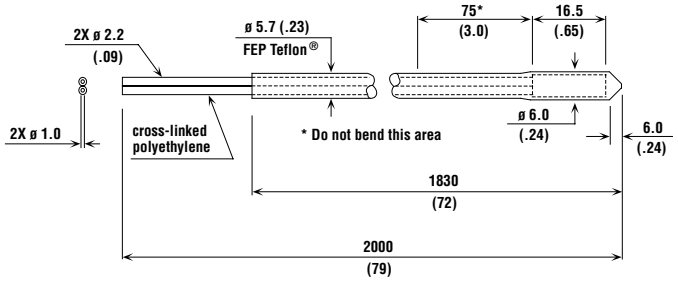
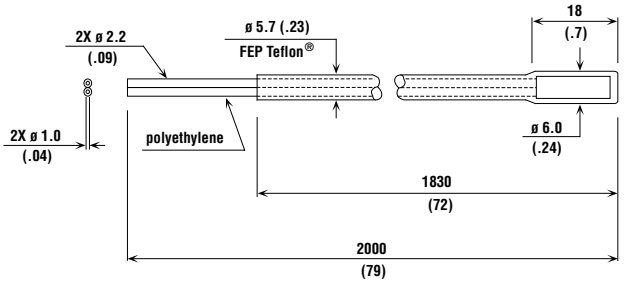
- Teflon-encapsulated fiber optic assemblies, which can survive harsh environments containing caustic materials, including acids;
- Liquid level probes which cause the sensor's output to switch when liquid contacts the sensing tip;
- Convergent mode sensing heads;
- Slot sensors

Also see the Custom Plastic Fiber Optic Section, beginning on page 664, for additional fiber otpic design ideas which are routinely used to solve special application requirements.

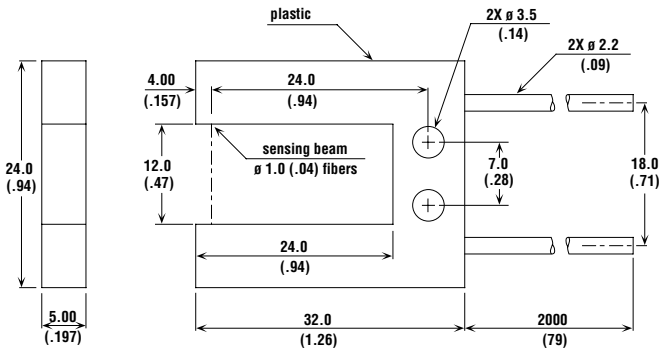
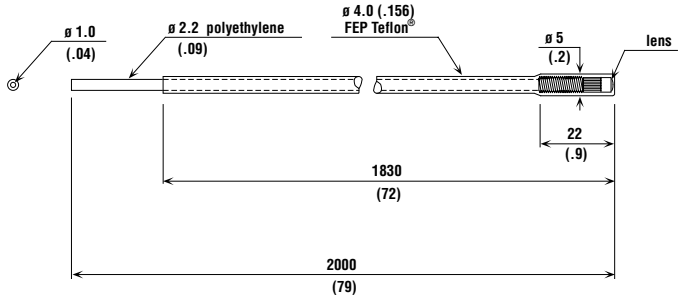
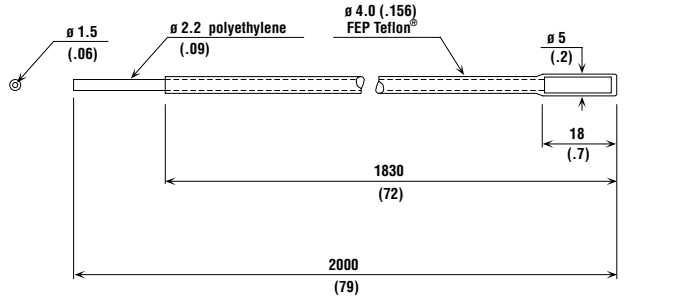
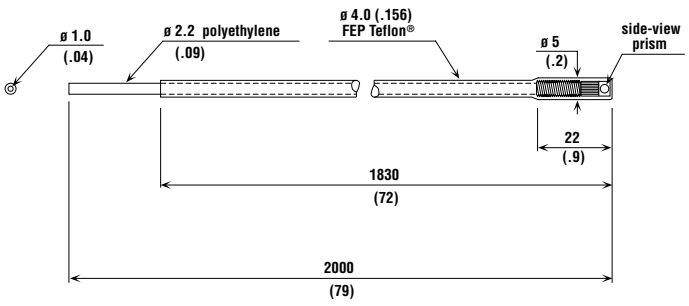
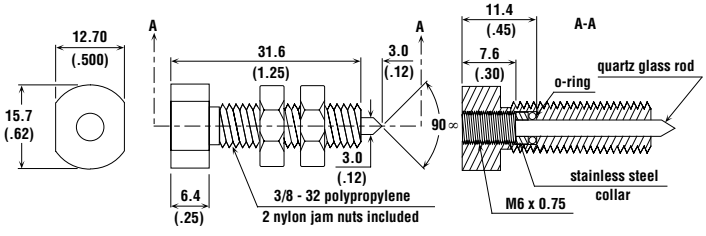
Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
New! **BMT16.6S-HT**	Bifurcated Threaded	1.6 mm Glass Fiber*	Terminated sensor end; use w/D10 plastic fiber sensors; SS protective sheath, M4 threaded tip	
New! **IMT.756.6S-HT**	Individual Threaded	1.3 mm Glass Fiber*	Terminated sensor end; use w/D10 plastic fiber sensors; SS protective sheath, M4 & M2.5 threaded end tip, may be used w/L2 & L2RA lens	
P12-C1	Convergent Side Exit	0.5 mm	Cut to length cable, 3 mm ± 0.5 mm convergent range, plastic housing	

* These fiber optic assemblies have end tips which employ special high temperature epoxy which can withstand up to 315°C (600°F) continuous environments.

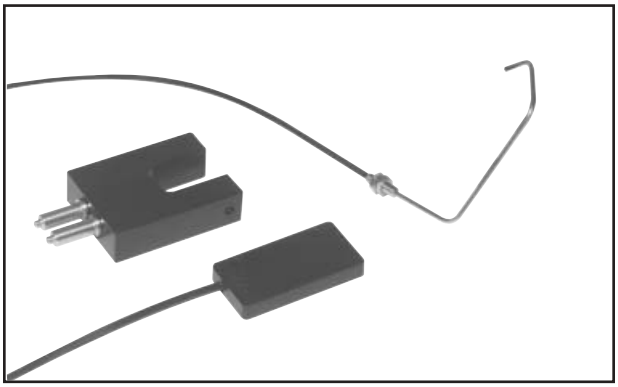
Special Application Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
P22-C1	Convergent Straight Exit	0.5 mm	Cut to length cable, 3 mm ± 0.5 mm convergent range, plastic housing	
New! **P32-C2**	Convergent Rectangular	0.5 mm	Cut to length cable, 2 mm ±0.5 mm convergent range, plastic "flat pack" housing	
PBE46UTMLLP	Bifurcated Liquid Level Probe Encapsulated	1.0 mm	Cut to length cable, end tip is completely encapsulated in Teflon®, sensor output switches when probe contacts liquid	
PBE46UTMLLPHT1	Bifurcated Liquid Level Probe Encapsulated	1.0 mm	Cut to length 125°C (257°F) high temperature cable, end tip is completely encapsulated in Teflon®	
PBE46UTMNL	Bifurcated Encapsulated	1.0 mm	Cut to length cable, end tip is completely encapsulated in Teflon®	

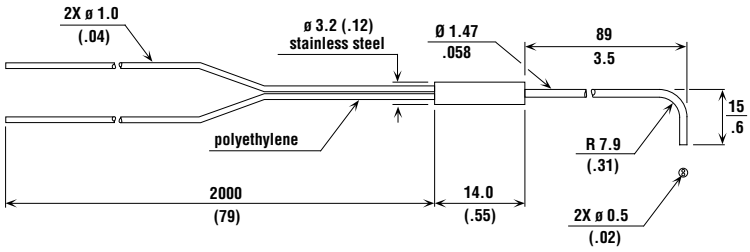
Special Application Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PDIS46UM12 **PDIS46UHFM12**	Dual Individual	1.0 mm	Cut to length cable; slot sensor; 12 mm (0.47") gap	
PIE46UT	Individual Lensed Encapsu-lated	1.0 mm	Cut to length cable, end tip is completely encapsulated in Teflon®	
PIE66UTMNL	Individual Encapsu-lated	1.5 mm	Cut to length cable, end tip is completely encapsulated in Teflon®	
PIES46UT	Individual Side View Encapsu-lated	1.0 mm	Cut to length cable, end tip is completely encapsulated in Teflon®	
TGR3/8MPFMQ	Liquid Level Probe	N/A	Polypropylene housing,quartz glass rod, use with PBT46U fiber, sensor output switches when probe contacts liquid	

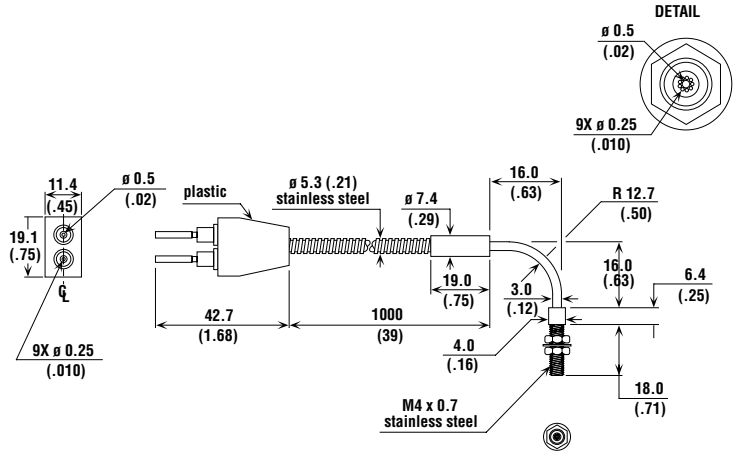
Custom Plastic Fibers



Banner would like the opportunity to solve your most challenging sensing applications, using custom-designed plastic fiber optics. Following are just a few examples of custom plastic fiber optic assemblies which have been produced, to date. Contact your local sales engineer or our factory application experts to discuss the details of your application requirements.

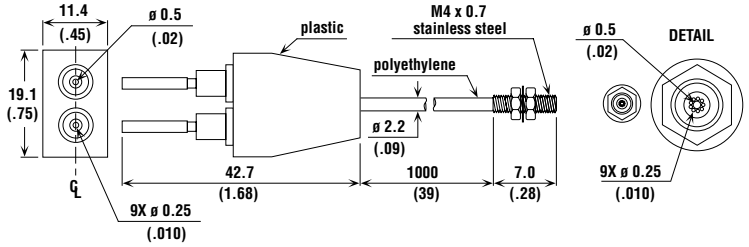
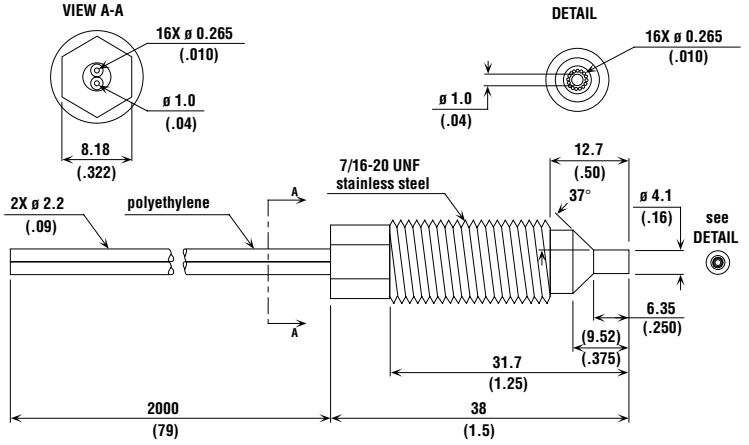
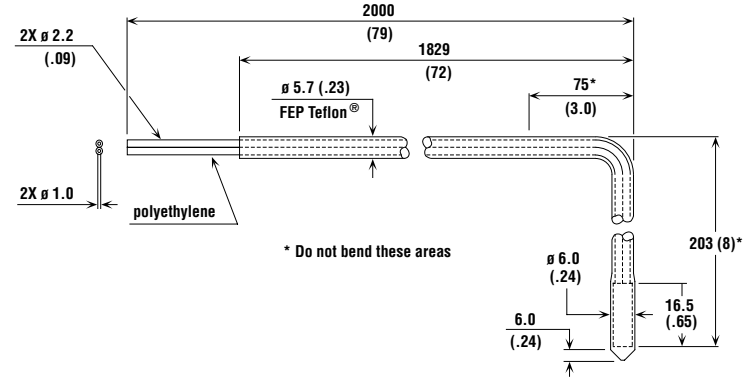
Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBA26UM3.5X.6	Bifurcated Angled	0.5 mm	Cut to length cable, non-bendable, angled probe end tip	

This angled probe fiber has been custom designed to fit a tight sensing area. Banner plastic fibers can be manufactured with almost any probe bend dimensions. Plastic fibers are ideal for applications where non-conductivity is necessary, such as high voltage.

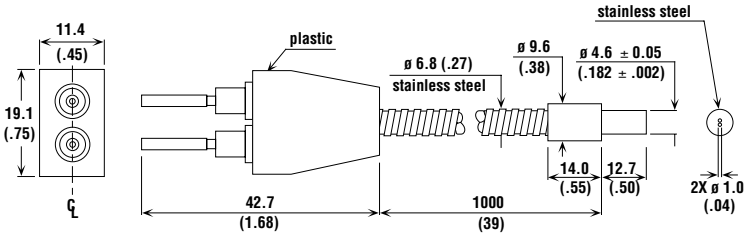
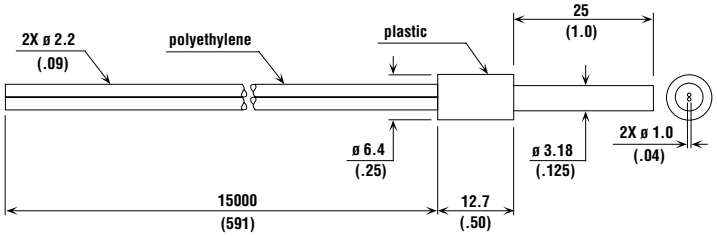
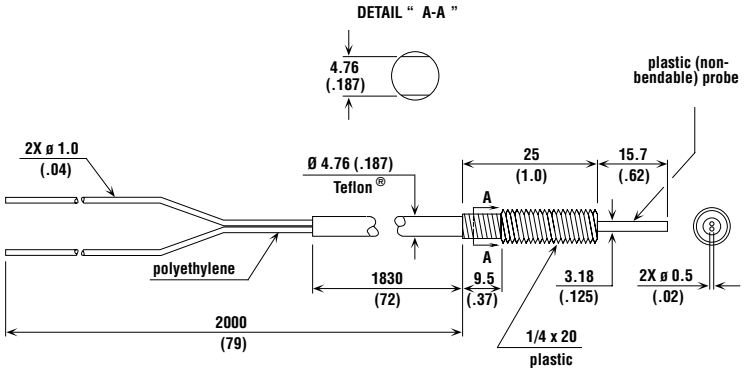
Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBCAT23TS	Bifurcated Coaxial Angled Threaded	1 x 0.5 mm 9 x 0.25 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors M4 threaded end tip, may be used w/L4C6 lens	

This fiber is an example of a coaxial bundle configuration with a 90° angle probe and a threaded end tip. Stainless steel sheathing and a D12/D11 style connector have been added.

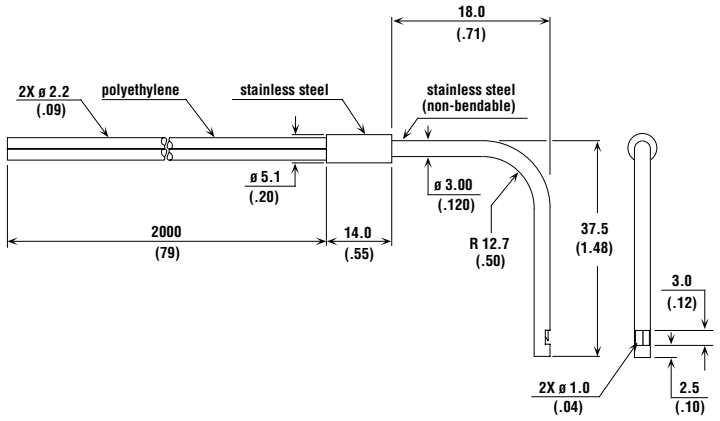
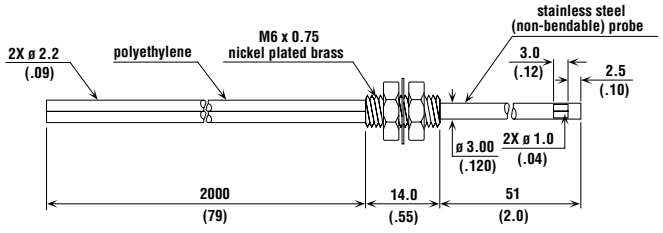
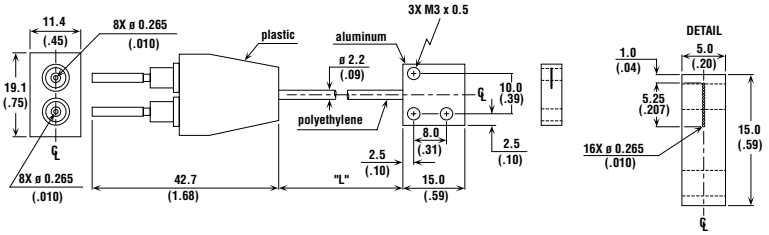
Custom Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBCT23TMT7	Bifurcated Coaxial Threaded	1 x 0.5 mm 9 x0.25 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors M4 threaded end tip, may be used w/L4C6 lens	
Use of the L4C6 convergent lens with fiber model PBCT23TMT7, which has a modified M4 x 0.7 threaded tip, allows for installation of the fiber in tight locations due to the reduced length of the end tip (7.0 mm as opposed to 18.0 mm). This is the shortest thread length possible for the coaxial fiber model PBCT23T.				
PBCT46UM7/16HX	Bifurcated Coaxial Threaded	1.0 mm	Cut to length cable, 7/16-20 threaded end tip	
This modification to standard fiber PBCT46U employs a larger, 7/16-20 UNF thread size, as well as a hex feature at the back of the end tip for ease of installation using a wrench.				
PBE46UTMLLPMA8	Bifurcated Liquid Level Probe Encapsu-lated Right Angle	1.0 mm	Cut to length cable, 90° bend, end tip is completely encapsulated in Teflon®, sensor output switches when probe contacts liquid	
The addition of a 90º bend to the Teflon® tubing on model PBE46UTMLLPMA8 allows the customer to mount the liquid level detecting tip through the wall of a containment vessel. This unit has the shortest possible vertical length of 200 mm (8") on the bend. Longer lengths can be manufactured upon request.				

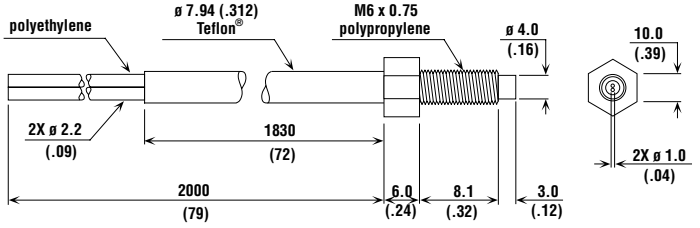
Custom Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBF43TSM.5X.19	Bifurcated Ferrule	1.0 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors SS protective sheath, smooth ferrule end tip	
This modification to a PBF46U uses a special ferrule which fits into an existing fixture, and stainless steel (SS) sheathing for mechanical protection.				
PBFM450UMNCM1	Bifurcated Ferrule Miniature	1.0 mm	Cut to length cable, smooth ferrule end tip	
Plastic fibers are ideal for applications where non-conductivity is necessary, such as high voltage. This modification has a plastic ferrule with an elongated 25 mm (1") long tip.				
PBP26UMTFEMNC	Bifurcated Threaded Probe	0.5 mm	Cut to length cable, non-bendable plastic probe, threaded ferrule, Teflon® protective sheath	
In addition to a non-conductive ferrule and probe, this fiber has a wrench flat on the back end of the 1/4-20 threaded ferrule. Teflon sheathing is added for ruggedness.				

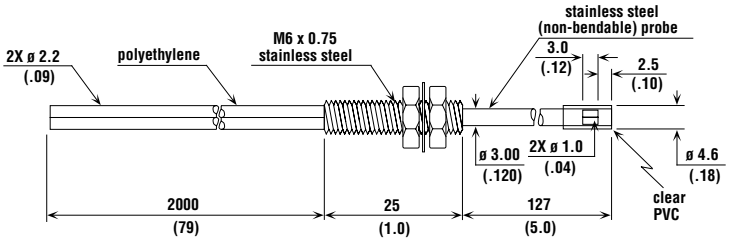
Custom Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBPS46UM.7X1.5	Bifurcated Probe Side View	1.0 mm	Cut to length cable, non-bendable angled side view probe end tip	
This is an example of a side view type fiber with a 90° angle bend in the probe. Plastic fibers can be used in applications involving very tight mounting constraints.				
PBPS46UMT	Bifurcated Probe Side View	1.0 mm	Cut to length cable, non-bendable angled side view probe end tip	
This side view type fiber has a threaded ferrule at the base of the probe for ease of mounting.				
PBR1X166T	Bifurcated Rectan-gular	16 x 0.265 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors Fiber array exits from end of aluminum housing	
This is a modification of standard plastic fiber PBR1X326U which has a smaller array length and the addition of a connector on the end of the fibers.				

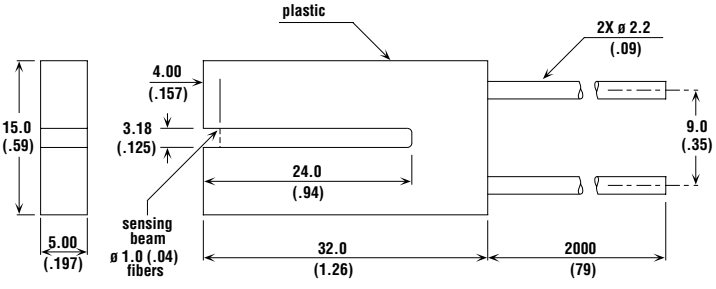
Custom Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PBT46UMHXMBMP	Bifurcated Threaded	1.0 mm	Cut to length cable, M6 threaded end tip, Teflon® protective sheathing	

This custom fiber is designed to be used with liquid level detection systems in conjunction with Banner liquid level probe TGR3/8MPFMQ. Polypropylene ferrule construction and Teflon sheathing provide resistance to harsh chemical environments. A hex feature on the back of the plastic ferrule aids in mounting.

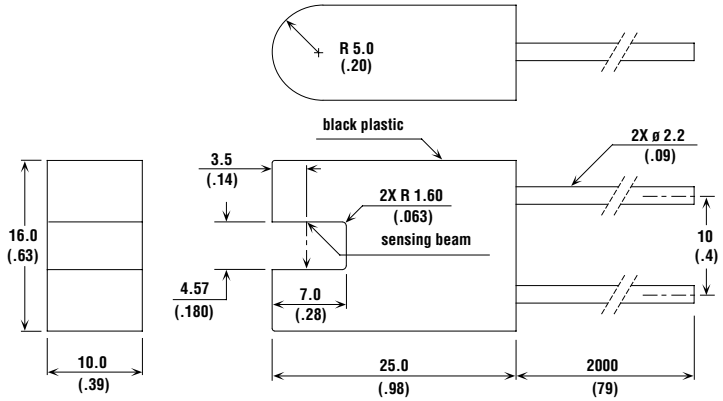
PBTPS46UMKC	Bifurcated Threaded Probe Side View	1.0 mm	Cut to length cable, M6 threaded ferrule, side view probe end tip	

This variation of standard fiber PBPS46U includes the addition of a 25 mm (1") long threaded ferrule for mounting ease, and a clear PVC sleeve over the sensing window in the probe to retard contamination of the fiber strands in dirty environments.

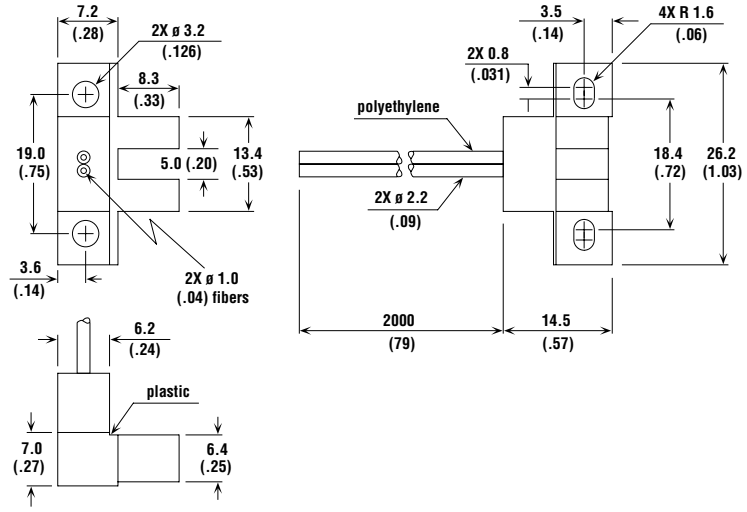
PDIS46UM3.2	Dual Individual Slot Sensor	1.0 mm	Cut to length cable, 3.18 mm (.125") gap, plastic housing	

The PDIS46MUM3.2 is a dual individual fiber optic used for edge guide or label sensing applications where control of a moving web is necessary. The housing is constructed of plastic with a 3.2 mm (1/8") wide slot to accommodate the 1.0 mm diameter effective opposed light beam.

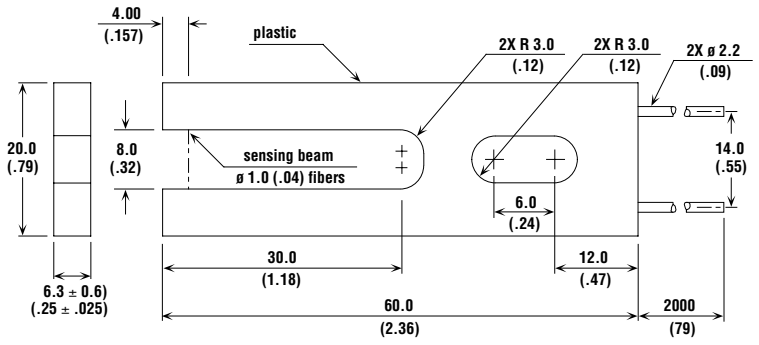
Custom Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PDIS46UM4.5	Dual Individual	1.0 mm	Cut to length slot sensor, 4.5 mm (0.18") gap	

This dual individual fiber is used in place of small inductive sensors in coin counting applications. The opposed 1 mm sensing beam can detect objects of any material that can fit through the 4.5 mm wide slot. Banner can manufacture custom fiber optics with any slot width and any housing shape desired for a particular application.

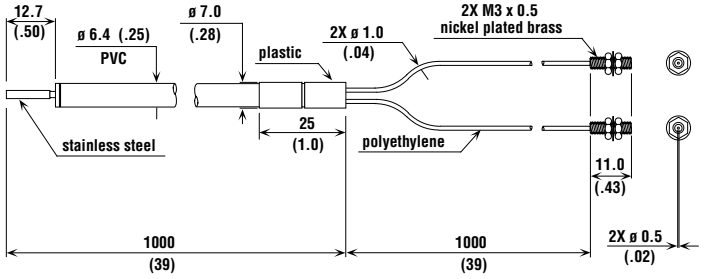
PDISM46UM5MA	Dual Individual Right Angle	1.0 mm	Cut to length cable, 5 mm (.20") separation, plastic housing	

Fiber model PDISM46UM5MA is a dual individual style unit with tight right angle packaging, allowing sensing in tight locations. This fiber has a 5.0 mm gap width and a 1.0 mm beam diameter.

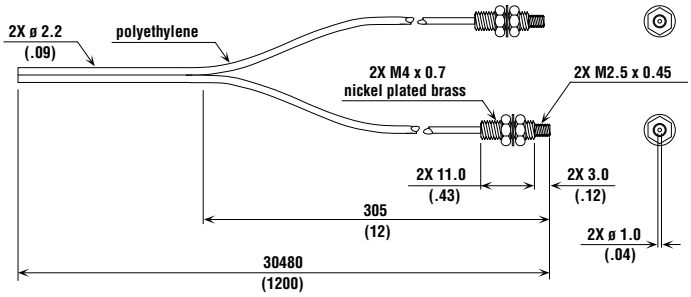
PDIS46UM8MSL30	Dual Individual Slot Sensor	1.0 mm	Cut to length cable, 8 mm (.32") gap, plastic housing	

This is another variation on the edge guide/label sensing fiber, with the addition of a mounting slot. This slot width is 8 mm (.32").

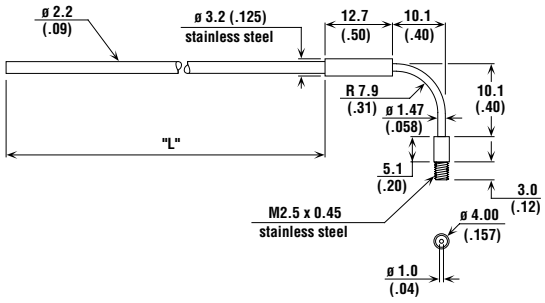
Custom Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PDIT26TP	Dual Individual Threaded	1.0 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors PVC protective sheath, M3 threaded end tips	

The PDIT26TP fiber is designed to be used in the opposed mode to create either “Dark-AND” or “Light-OR” logic functionality. Threaded end tips are used, as well as a PVC sheathing for protection. This fiber cable is designed to be used with the D11/D12 series of photoelectric sensors.

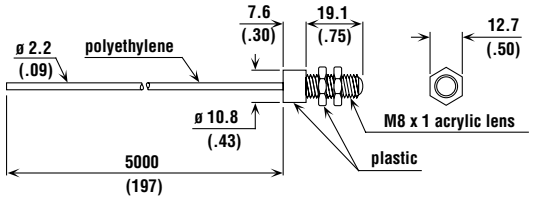
PDIT4100U	Dual Individual Threaded	1.0 mm	Cut to length, M4 & M2.5 threaded end tips, may be used w/L2 and L2RA lens	

The PDIT4100U combines PIT46U-style threaded end tips with 30 m (100') length in a duplex 1.0 mm core fiber optic cable. This is useful in applications where emitter and receiver fibers can be routed in the same cable run for convenience.

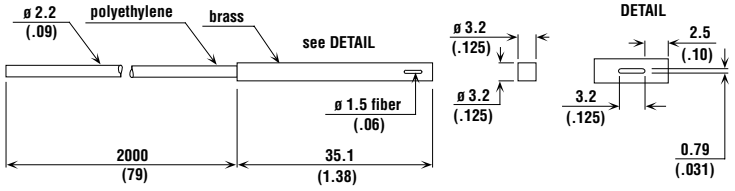
PIAT46UM.4X.4MT	Individual Angled Threaded	1.0 mm	Cut to length, M2.5 threaded end tip, may be used w/L2 and L2RA	

This modification to the PIA46U is for use with L2 lenses for the longest opposed range in a “tight” side view application. The angle tip has the minimum 7.9 mm (0.31") bend radius allowed for this particular type of steel tubing.

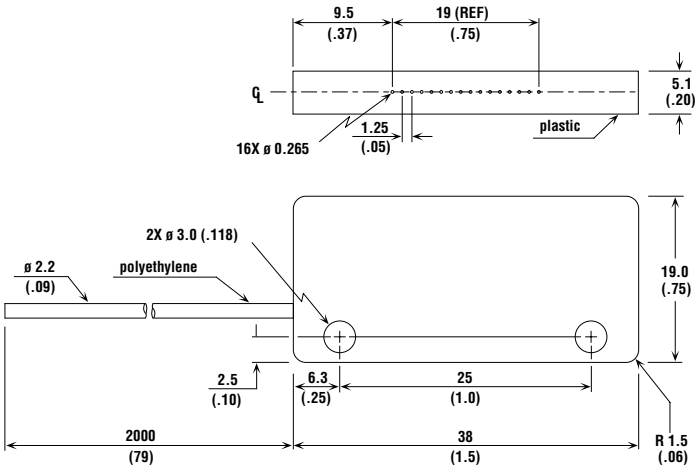
Custom Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIL415U	Individual Lensed	1.0 mm	Cut to length cable, 8 mm lens	

Used with special sensor model D12DAB6FPH High Power AC-Coupled sensor, this, lensed fiber optic cable allows for opposed ranges of up to 10 m (30'), where small 1 mm (0.040") “thread break” detection is required.

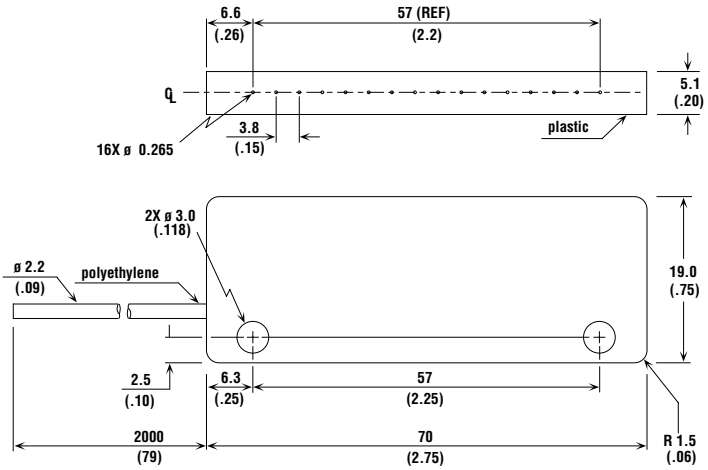
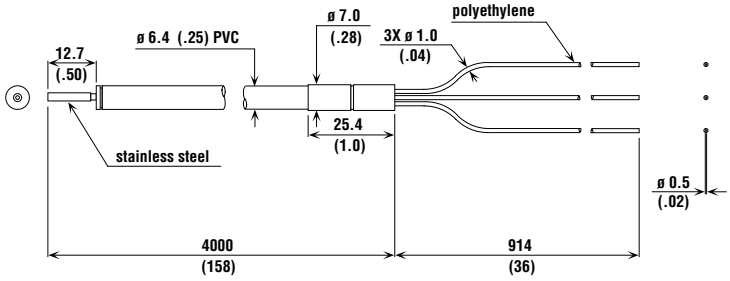
PIPS66UMSQMAP	Individual Probe Side View	1.5 mm	Cut to length cable, apertured side view end tip	

This special modification to standard fiber model PIPS66U includes an apertured slot through which the fiber optic light beam passes. This allows for more reliable detection of an object passing through the opposed beam which may have an irregular edge profile, such as a postage stamp.

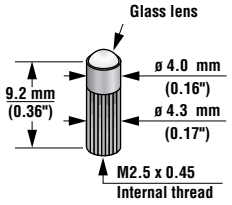
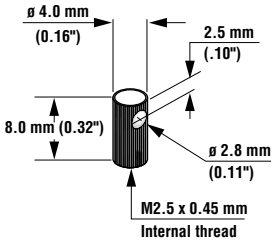
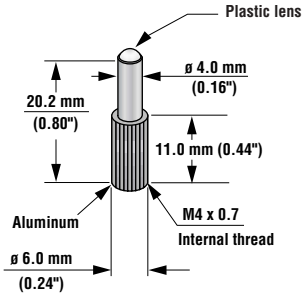
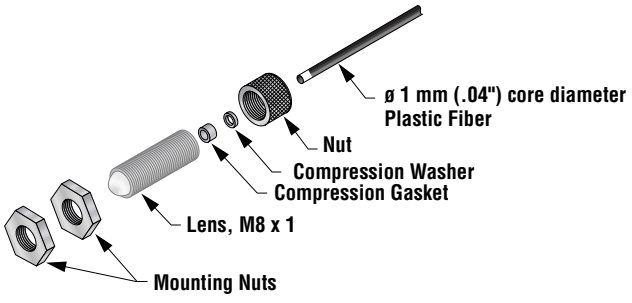
PIRS1X166UMPM.75	Individual Rectan-gular Side Exit	16 x 0.265 mm	Cut to length cable, fiber array exits from side of plastic housing	

Similar to standard fiber PIRS1X166UMPMAL, this modified “array” style fiber has a plastic housing and a different spacing between the individual light beams. Banner can design any configuration desired with any beam spacing needed for achieving a particular fiber “line” that suits the application.

Custom Plastic Fibers

Model	Type	Fiber Core Size	Construction	Dimensions (mm over inches)
PIRS1X166UMPM2.2	Individual Rectangular Side Exit	16 x 0.265 mm	Cut to length cable, fiber array exits from side of plastic housing	
Modified array fiber with longer housing and 3.8 mm (.15") beam spacing, yielding an overall array length of 57 mm (2.2").				
PTIU216TP	Tri-individual Unterminated	0.5 mm	Terminated sensor end; use w/D11 & D12 plastic fiber sensors PVC protective sheath, unterminated end tips	
This Tri-Individual fiber is used with one photoelectric sensor to create three opposed beams. When the sensor is used in the dark operate mode, a “DARK-AND” logic function results. The sensor output energizes only when all three branches are completely blocked. This model can be produced with virtually any standard 0.5 mm (0.020") end tip configuration, to satisfy particular sensing requirements. Note: Two are required per sensor.				

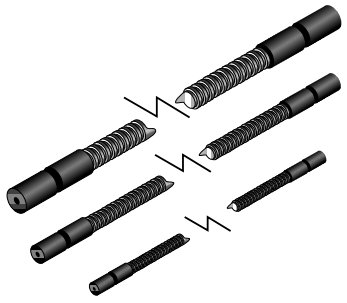
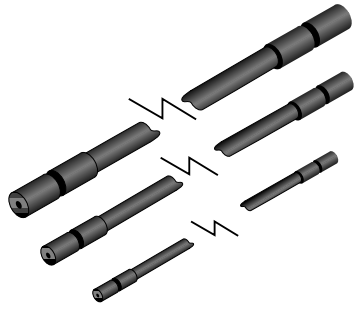
Lenses

Model	Description		
L2	• Lens for extended range operation with opposed mode fibers. • Use with PIT46U or PIT46UC • The housing is made of nickel plated brass; the lens is glass • -60° to +350°C (-60° to +662°F)		
L2RA	• Right angle prism for 90° beam deflection; reduces range • Use with model PIT46U or PIT46UC • The housing is made of nickel plated brass; the prism is glass • -60° to +300°C (-60° to +572°F)		
L4C6	• Convergent lens for use with 0.5 mm/9 x 0.25 mm coaxial fiber optic assemblies with M4 x 0.7 threaded end tip • Focal distance is 6 mm ±1 mm (0.24" ±0.04") • Spot size is 0.25 mm (0.010") • The housing is made of anodized aluminum; the lens is acrylic • -40° to +70°C (-40° to +158°F)		
L08FP **PIL46U** **PIL46UHF**	• The easily-installed L08FP lens assembly may be used to extend the opposed mode sensing range of 1 mm (0.04") unterminated plastic fiber optic models PIU430U or PIU460U • A pair of 6-foot long 1 mm (0.04") diameter individual fibers with factory-installed model model L08FP lenses is available as plastic fiber optic assembly model PIL46U		

Plastic Fiber Field-Installable Sheathing

Using model PFS69S6T as an example, the model numbering scheme for field-installable sheathing is as follows:

First three digits are alpha "PFS"	= Plastic Fiber Field-installable Sheathing
Next two digits are numerical "69"	= Outside Diameter (OD) in mm (e.g. 6.9 mm)
Next digit is alpha "S"	= Stainless Steel (S) or PVC (P) sheathing material
Next digit is numerical "6"	= Length of cable assembly in' (e.g. 6')
The last digit is alpha "T"	= Modification Designator (on special models only) (e.g. T = Threaded)

Model	Description	
PFS69S6 **PFS53S6** **PFS44S6**	• Stainless steel sheathing with plastic compression fitting is used in applications where protection is required for plastic fiber optic cables • PFS69S6 is used with bifurcated 1 mm (0.04") or 1.5 mm (0.06") diameter core fibers • PFS53S6 is used with individual 1 mm (0.04") or 1.5 mm (0.06") diameter or bifurcated 0.25 mm (0.01") and 0.5 mm (0.02") diameter core fibers • PFS44S6 is used with individual 0.25 mm (0.01") and 0.5 mm (0.02") diameter core fibers • All models listed are 2 m (6') in length • Other lengths are available by contacting Banner Applications Department	
PFS95P6 **PFS64P6** **PFS40P6**	• PVC sheathing with plastic compression fitting is used in applications where protection is required for plastic fiber optic cables • PFS95P6 is used with bifurcated 1 mm (0.04") or 1.5 mm (0.06") diameter core fibers • PFS64P6 is used with individual 1 mm (0.04") or 1.5 mm (0.06") diameter or bifurcated 0.25 mm (0.01") and 0.5 mm (0.02") diameter core fibers • PFS40P6 is used with individual 0.25 mm (0.01") and 0.5 mm (0.02") diameter core fibers • All models listed are 2 m (6') in length • Other lengths are available by contacting Banner Applications Department	
PFS69S6T **PFS53S6T** **PFS44S6T**	• Stainless steel sheathing with stainless steel end fittings (one end internally threaded to capture fiber end tips, other end non-threaded), is used in applications where protection is required for plastic fiber optic cables • PFS69S6T may be used with bifurcated fiber assemblies having M6 x 0.75 threaded end tips (PBCT46U, PBP46U, PBT46UHT1, and PBT66U) • PFS53S6T may be used with individual or bifurcated fiber assemblies having M4 x 0.7 threaded end tips (PBCT26U, PBPF26U, PIP46U, PIT46U, PIT46UHT1, and PIT66U) • PFS44S6T may be used with individual fiber assemblies having M3 x 0.5 threaded end tips (PIP26U, PIT26U, PIT1X46U, and PITF26U) • All models listed are 2 m (6') in length • Other lengths are available by contacting Banner Applications Department	

Raw Plastic Fiber Field-Installable Sheathing

Banner also offers individual field-installable sheathing components for customized assembly. These components are for stainless steel sheathing only. Assembly is the responsibility of the customer. Tools or assembly materials are NOT supplied.

Sheathing

Model	Description
FS69S30	Roll of raw SS sheathing, 6.9 mm OD (PFS69S6), 9 m (30') long
FS53S30	Roll of raw SS sheathing, 5.3 mm OD (PFS53S6), 9 m (30') long
FS44S30	Roll of raw SS sheathing, 4.4 mm OD (PFS44S6), 9 m (30') long

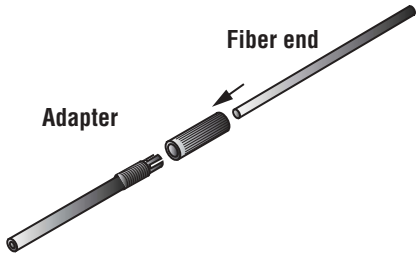
Fittings

RCF69-10	Plastic compression fittings (PFS69S6), bag of 10	Same parts as used on model PFS69S6T
RCF69MSST-10	Stainless steel end fittings, internally threaded M6 x 0.75, bag of 10	
RCF69MSS-10	Stainless steel end fittings, non-threaded, bag of 10	
RCF53-10	Plastic compression fittings (PFS53S6), bag of 10	Same parts as used on model PFS53S6T
RCF53MSST-10	Stainless steel end fittings, internally threaded M4 x 0.7, bag of 10	
RCF53MSS-10	Stainless steel end fittings, non-threaded, bag of 10	
RCF44-10	Plastic compression fittings (PFS44S6), bag of 10	Same parts as used on model PFS44S6T
RCF44MSST-10	Stainless steel end fittings, internally threaded M3 x 0.5, bag of 10	
RCF44MSS-10	Stainless steel end fittings, non-threaded, bag of 10	

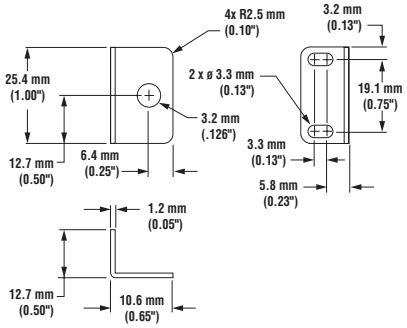
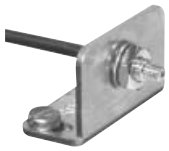
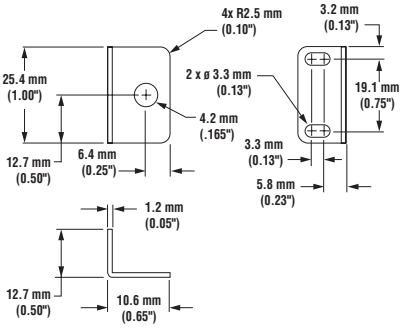
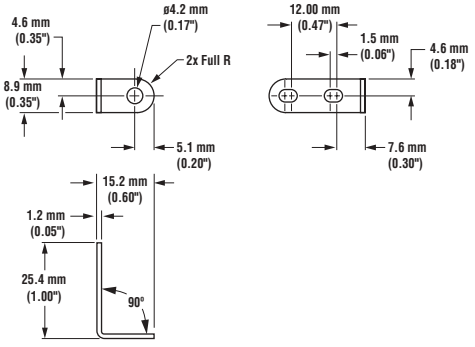
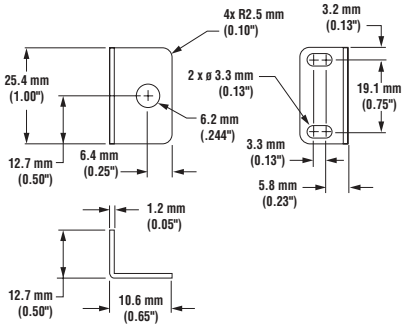
Unterminated Individual and Bifurcated Plastic Fibers

Model	Core	Length	Type	
PIU230U	0.5 mm (0.02")	9 m (30')	Single	
PIU260U	0.5 mm (0.02")	18 m (60')	Single	
PIU430U	1.0 mm (0.04")	9 m (30')	Single	
PIU460U	1.0 mm (0.04")	18 m (60')	Single	
PIU630U	1.5 mm (0.06")	9 m (30')	Single	
PIU660U	1.5 mm (0.06")	18 m (60')	Single	
PBU430U	1.0 mm (0.04")	9 m (30')	Duplex	
PBU460U	1.0 mm (0.04")	18 m (60')	Duplex	

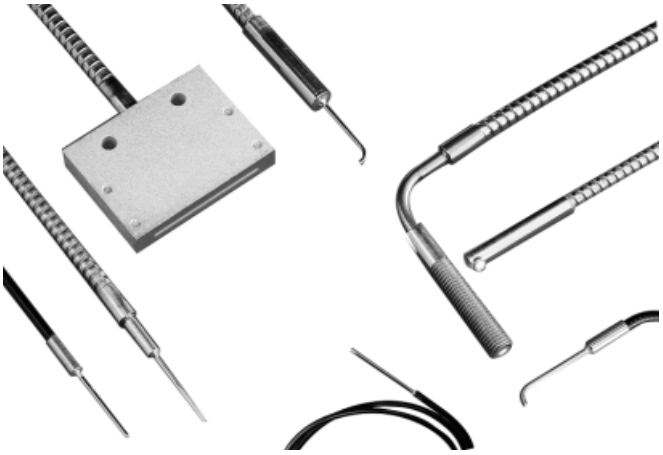
Plastic Fiber Kits

Model	Description	
PFK20 **PFK40**	• These kits are used with the unterminated plastic fiber cables • The PFK20 is for use with 0.25mm (0.01") and 0.5 mm (0.02") diameter cables • The PFK40 is for use with the 1 mm (0.04") and 1.5 mm (0.06") diameter cables • Each kit contains 40 bushings and 10 cutter assemblies (cutters can be purchased separately in packages of 25 - reference model **PFC-1-25**)	 NOTE: Bushings are not used with D11, D12, PC44, QM42, or MINI-BEAM sensors.
UPFA-1-100 **UPFA-2-100**	• Compression fitting adapters used with small diameter unterminated plastic fiber cables • Use when interfacing small diameter plastic fibers to D11, D12, D10, MINI-BEAM and R55F plastic fiber sensor families • Use UPFA-1 to adapt plastic fiber optic cables with outside jacket diameter of 1.0 mm (4.0") • Use UPFA-2 to adapt plastic fiber optic cables with outside jacket diameter of 1.25 mm or 1.3 mm (0.05") • Each kit contains 100 pairs of adapters. One pair will interface either one bifurcated fiber optic cable or a pair of individual cables to a fiber optic amplifier.	

Mounting Brackets

Model	Description	Dimensions
SMBFP3 	• Right angle bracket for plastic fiber optics with 3 mm threaded tip • 18-gauge stainless steel	
SMBFP4 	• Right angle bracket for plastic fiber optics with 4 mm threaded tip • 18-gauge stainless steel	
SMBFP4N 	• Low profile bracket for plastic fiber optics with 4 mm threaded tip • 18-gauge stainless steel	
SMBFP6 	• Right angle bracket for plastic fiber optics with 6 mm threaded tip • 18-gauge stainless steel	

Glass Fiber Optics



- Banner glass fibers solve numerous challenging sensing requirements including the most hostile environments such as high temperatures up to 480°C (900°F), corrosive materials and extreme moisture
- Due to low mass of the fibers, glass fibers can withstand high levels of shock and vibration; they are also immune to extreme electrical noise
- Glass fibers are constructed of a combination of optical glass fiber, stainless steel, PVC, brass, silicone rubber, Teflon®, molded thermoplastics, and optical grade epoxy

APPLICATION NOTES and WARNINGS

1. The ends of glass fiber optic assemblies are optically ground and polished. Care taken in this manufacturing process accounts for the light coupling efficiency of the fiber optic assembly. As a result, glass fiber assemblies cannot be shortened, spliced, or otherwise modified.
2. Use caution when applying fiber optics in hazardous locations. Although fiber optic assemblies are, by themselves, intrinsically safe, the sensor and associated electronics must be LOCATED IN A SAFE ENVIRONMENT. Alternatively, fiber optics may be used with sensor model SMI912FQD (page 359). This sensor is approved for use inside hazardous areas when used with an appropriate intrinsic barrier. Also, see NAMUR sensor models Q45AD9F (page 416) and MIAD9F (page 148). Fiber optics do not necessarily provide a hermetic seal between a hazardous environment and the safe environment.
3. In applications where glass fibers are being used to insulate the control from high voltage, specify silicone rubber, teflon, or high-density polyethylene sheathing with no reinforcing wire in the cable. It is the responsibility of the user to test each fiber optic assembly for insulation capacity.
4. Do not subject the fibers to sharp bends, pinching, repeated flexing, or high levels of radiation.
5. When ordering fiber lengths in excess of 1 m (3'), take into account light signal reduction of 5 percent per foot of additional length.

Teflon® is a registered trademark of Dupont

Model Numbering Scheme for Glass Fiber Optic Assemblies

ASSEMBLY STYLE designator
(one or two letters)

B = Bifurcated: emitter & receiver to one sensing point
DB = Double bifurcated: emitter & receiver to two sensing points
H = Hex-individual: emitter or receiver to six sensing points
HB = Hex-bifurcated: emitter & receiver to six sensing points
I = Individual: emitter or receiver to one sensing point
O = Octa-individual: emitter or receiver to eight sensing points
OB = Octa-bifurcated: emitter & receiver to eight sensing points
P = Penta-individual: emitter or receiver to five sensing points
PB = Penta-bifurcated: emitter & receiver to five sensing points
Q = Quad-individual: emitter or receiver to four sensing points
QB = Quad-bifurcated: emitter & receiver to four sensing points
T = Tri-individual: emitter or receiver to three sensing points
TB = Tri-bifurcated: emitter & receiver to three sensing points

SHEATHING MATERIAL designator

S = Stainless steel flexible conduit
P = PVC with galvanized monocoil reinforcing wire
L = Silicone rubber tubing (max. flexibility, min. fiber protection)
T = Teflon tubing (max. chemical resistance, min. flexibility)
HDP = High-density polyethylene (max. electrical isolation, min. flexibility)

FIBER BUNDLE DIAMETER designator
(in 1/16 of an inch)

.44 = 0.027" (0.7 mm)
.5 = 0.032" (0.8 mm)
.75 = 0.046" (1.2 mm)
1 = 0.062" (1.6 mm)
1.5 = 0.090" (2.3 mm)
2 = 0.125" (3.2 mm)
2.5 = 0.156" (4.0 mm), max bundle ø

I A T 2 3 S X X

MODIFICATIONS designator
(suffix may be any length)

"M600" suffix = Cable available in 600°F version
"M900" suffix = Cable available in 900°F version

SENSING END TIP STYLE designator
(one to five letters)

A = Angled tip (90°)
AC = Axial circular (ring-shaped) fiber termination
AM = Angled tip (90°); miniature probe (ø0.059")
AMM = Angled tip (90°); micro-miniature probe (ø0.043")
AR = Angled tip (90°); rectangular bundle termination (plastic insert)
AT = Angled (90°) & threaded (5/16 -24 x 1 1/2" long) brass tip
ATR = Angled (90°)& threaded tip; miniature rectangular bundle (plastic insert)
F = Ferruled (ø 3/16 x 1/2" long) tip; same as sensor end tip
FR = Ferruled tip; miniature rectangular bundle termination (plastic insert)
HA = Half-angled tip (45°)
HAR = Half-angled tip (45°); miniature rectangular bundle (plastic insert)
HAT = Half-angled (45°) & threaded (5/16 -24 x 1 1/2" long) brass tip
HATR = Half-angled and threaded tip; miniature rectangular bundle (plastic insert)
M = Miniature (ø0.059 x 1" long) tip
MAP = Miniature angled (90°) probe tip
MHAP = Miniature half-angled (45°) probe tip
MM = Micro-miniature (ø0.043 x 1" long) probe tip
MP = Miniature (ø0.059 x 1" long) probe, ø0.15 x 0.5" long ferrule
MT = Threaded (#8-32 x 0.5" long) brass end tip
MTAP = Threaded (#8-32 x 0.5" long) brass, miniature angled (90°) tip
MTHAP = Threaded (#8-32 x 0.5" long) brass, miniature half-angled (45°) tip
MTP = Threaded (#8-32) brass, miniature (ø0.059 x 1" long) probe
P = Probe (ø0.09 x 3" long) bendable tip
R = Rectangular bundle termination
RC = Radial circular light image around perimeter of tip
T = Threaded (5/16 -24 x 1 1/2" long), brass end tip
TA = Threaded (5/16 -24 x 1 1/2" long), angled (90°) end tip
TAR = Threaded (5/16 -24) angled (90°); miniature rectangular bundle (plastic insert)
THA = Threaded (5/16 -24 x 1 1/2" long), half-angled (45°) end tip
THAR = Threaded & half-angled (45°); miniature rectangular bundle (plastic insert)
TR = Threaded end tip; miniature rectangular bundle termination (plastic insert)

OVERALL LENGTH designator

Length of the complete fiber optic assembly in feet

SHORT FIBER OPTIC MODEL NUMBERING

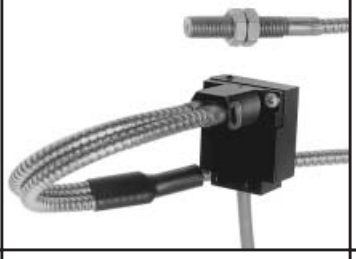
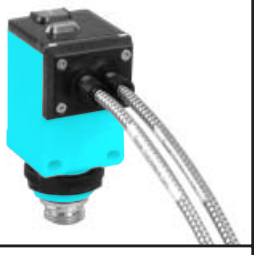
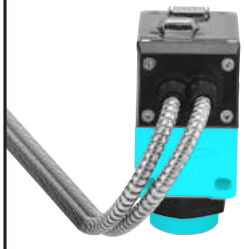
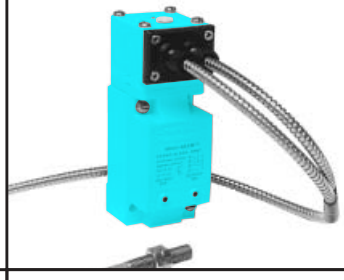
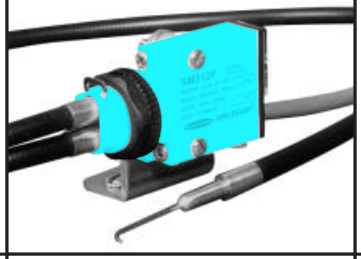
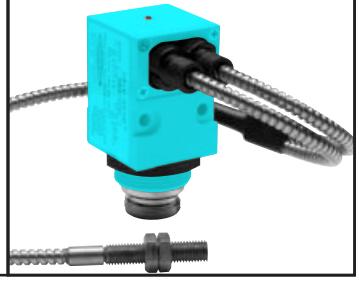
The overall length dimensions of short fiber optic assemblies may be specified to the nearest inch. Use the numbers below to specify lengths that are not an even multiple of 12 inches

Overall Length		Model Number
1"	=	.1
2"	=	.2
3"	=	.3
4"	=	.33
5"	=	.4
6"	=	.5
7"	=	.6
8"	=	.7
9"	=	.8
10"	=	.83
11"	=	.9

e.g. to order model number IA23S in a 10" length, order "IA2.83S"

The following Banner fiber optic products use glass fibers for sensing applications.

Sensors for Glass Fiber Optics Quick Reference Guide

D12 Series Glass Fiber Optic Models (pp. 618, 622, 623 & 630)		**OMNI-BEAM** Glass Fiber Optic Models (pp. 430-433, & 447)	
ECONO-BEAM Glass Fiber Optic Models (p. 162)		**Q45 Series** Glass Fiber Optic Models (pp. 385 & 416)	
LR/PT400 with FOF-400 Glass Fiber Optic Fittings (p. 587)		**Q45X Bus Network Sensors** Glass Fiber Optic Models (p. 403)	
MAXI-BEAM Glass Fiber Optic Models (pp. 461 & 462)		**R55F** Glass Fiber Optic Models (p. 306)	
MINI-BEAM Glass Fiber Optic Models (pp. 120, 121, 131, 132, 143 & 148)		**SM512** Glass Fiber Optic Models (p. 278)	
MULTI-BEAM Glass Fiber Optic Models (pp. 485-488, 503 & 509)		**VALU-BEAM** Glass Fiber Optic Models (pp. 331, 342, 350, 358 & 359)	

Glass Fiber Optics Specifications

Construction	Combination of optical glass fiber, stainless steel or PVC, brass silicone rubber, Teflon®, molded thermoplastics, and optical grade epoxy. Optical fiber is F2 core, EN1 clad, except where noted. Flexible steel interlock sheathing is 302 stainless, except where noted.
Sensing Range	Refer to the excess gain curves for the fiber optic sensor to be used.
Bend Radius	Inside bend radius must be 0.5" (12 mm) or greater for PVC covered fiberoptic assemblies, and 1" (25 mm) or greater for stainless steel armored cable covered fibers.
Length	Standard length for assemblies is 24" (610 mm) or 36" (915 mm); see dimension diagrams Most models are available from the factory with shorter or longer cable lengths, up to 60' (18 m) max
Length Dimension Tolerance	Overall assembly length is ± 0.5" (12 mm) per 1' of length Bifurcation dimensions: ±0.5" (12 mm)
Implied Dimensional Tolerance	All glass fiber optic dimensions are in inches: 0.xxx = ±0.005 in; 0.xx = ±0.01; 0.x = ±0.1, unless specified
Operating Conditions	Fiber assemblies with stainless steel (SS) sheathing and metal end tips: -140° to +249°C (-220° to +480°F) Fiber assemblies with PVC sheathing and/or plastic end tips: -40° to +105°C (-40° to +220°F) Special order assemblies with SS sheathing and metal end tips and model suffix "M600": -140° to +315°C (-220° to +600°F) *sensing end tip only Special order assemblies with SS sheathing and metal end tips and model suffix "M900": -140° to +480°C (-220° to +900°F); note dimensional changes from STD models * sensing end tip only

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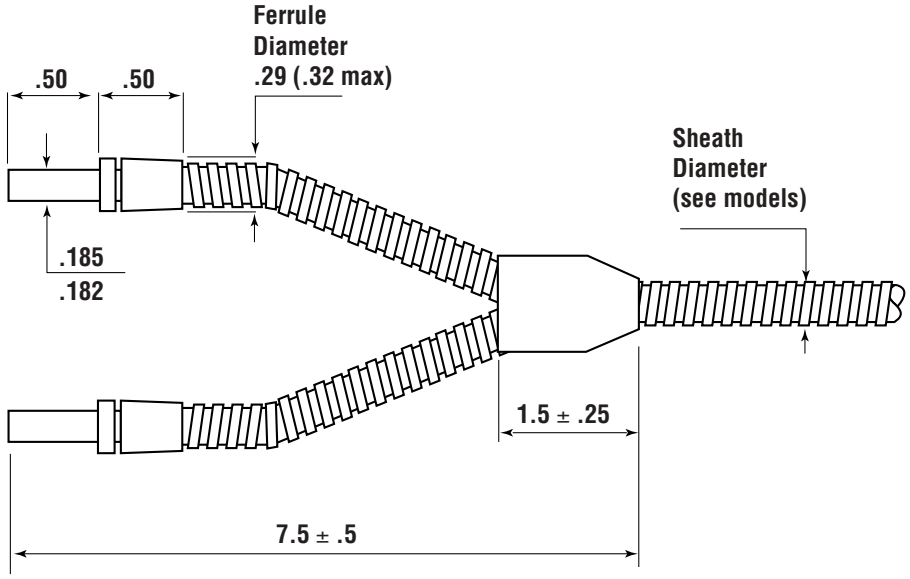
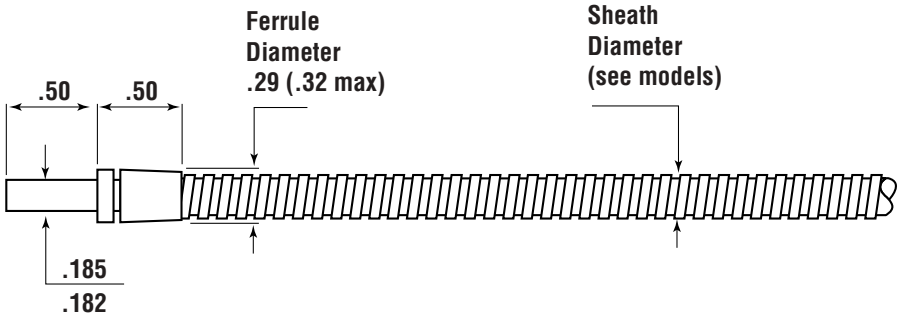
Glass Fiber Optic Construction

Bifurcated Fiber Construction

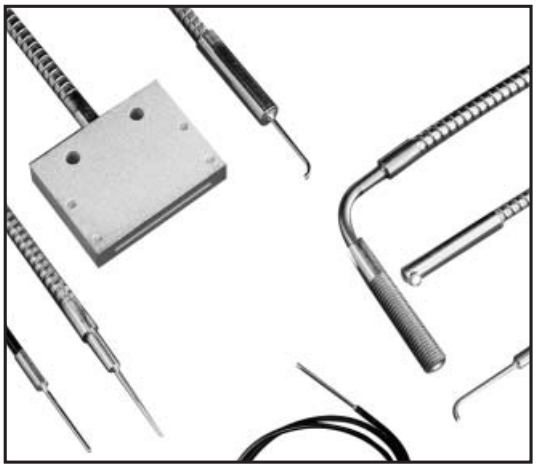


Individual Fiber Construction

NOTE: Two individual glass fibers are required per sensor for opposed mode sensing.

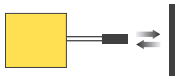


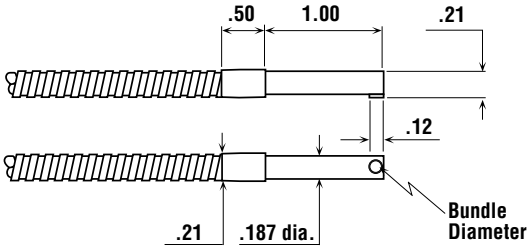
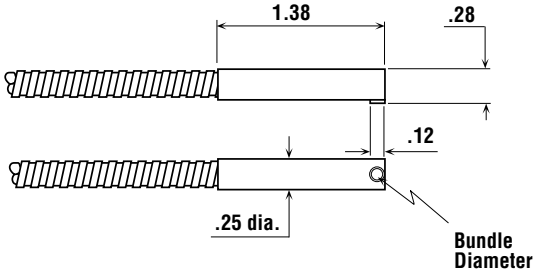
Standard Glass Fibers



Following is the listing of Banner standard, stocked glass fiber optic assemblies. Sensing end tips are common to both bifurcated ("B" model prefix) and individual ("I" model prefix) type assemblies. See page 681 for sensor end dimensions.

Contact your local sales engineer or factory applications expert for information on variations not listed, including: different final assembly lengths, additional bundle sizes, and alternate sheathing materials.

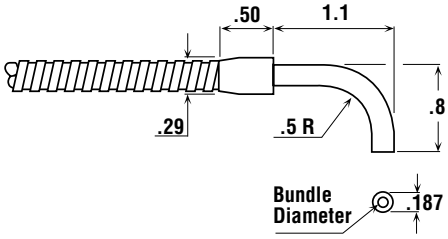
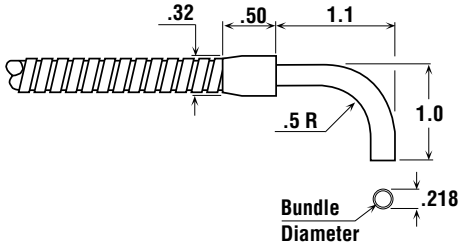
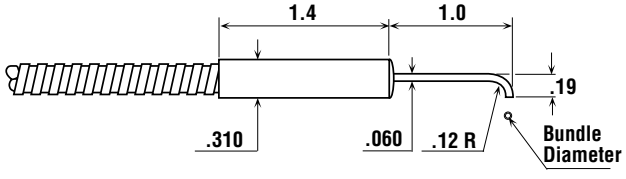


Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BA1.53PMETA	Diffuse	36	0.090	PVC	.19	
BA.753PMETA			0.046	PVC	.19	
BA13PMETA			0.062	PVC	.19	
BA1.53SMETA*			0.090	SS	.21	
BA.753SMETA*			0.046	SS	.21	
BA13SMETA*			0.062	SS	.21	
IA1.53PMETA	Opposed	36	0.090	PVC	.19	
IA.753PMETA			0.046	PVC	.19	
IA13PMETA			0.062	PVC	.19	
IA1.53SMETA*			0.090	SS	.21	
IA.753SMETA*			0.046	SS	.21	
IA13SMETA*			0.062	SS	.21	
BA1.53PMTA	Diffuse	36	0.090	PVC	.19	
BA.753PMTA			0.046	PVC	.19	
BA13PMTA			0.062	PVC	.19	
BA1.53SMTA*			0.090	SS	.21	
BA.753SMTA*			0.046	SS	.21	
BA13SMTA*			0.062	SS	.21	
IA1.53PMTA	Opposed	36	0.090	PVC	.19	
IA.753PMTA			0.046	PVC	.19	
IA13PMTA			0.062	PVC	.19	
IA1.53SMTA*			0.090	SS	.21	
IA.753SMTA*			0.046	SS	.21	
IA13SMTA*			0.062	SS	.21	

* Available in 600°F version by adding suffix "M600" to model number

** Available in 900°F version by adding suffix "M900" to model number (some dimensions may change)

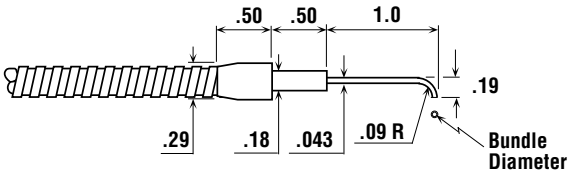
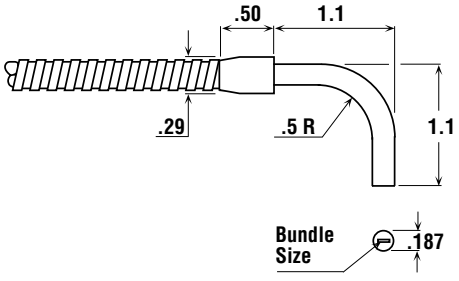
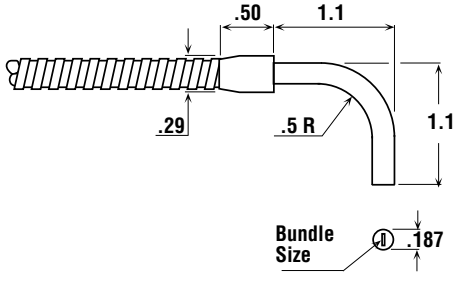
Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BA23S* ** **BA13P** **BA13S* **** **BA23P**	Diffuse	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	
IA23S* ** **IA13P** **IA13S* **** **IA23P**	Opposed	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	
BA2.53S* **BA2.53P**	Diffuse	36	0.156	SS PVC	.30	
IA2.53S* **IA2.53P**	Opposed	36	0.156	SS PVC	.30	
BAM.752S* **BAM.752P** **BAM.753S***	Diffuse	24 24 36	0.046	SS PVC SS	.25	
IAM.752S* **IAM.752P** **IAM.753S***	Opposed	24 24 36	0.046	SS PVC SS	.25	

* Available in 600°F version by adding suffix “M600” to model number

** Available in 900°F version by adding suffix “M900” to model number (some dimensions may change)

Standard Glass Fibers

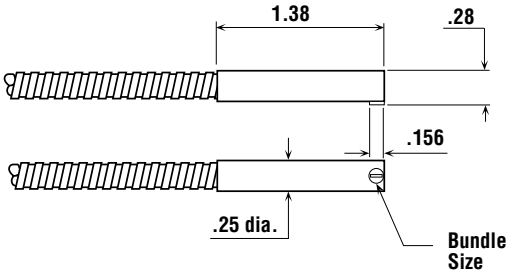
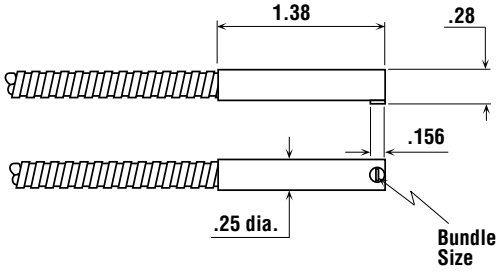
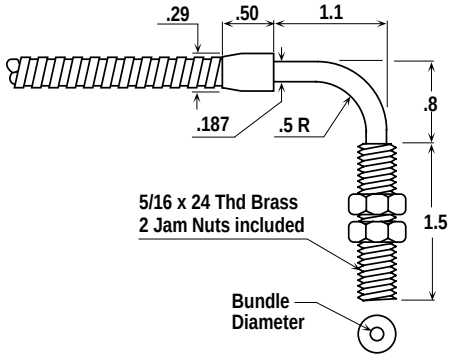
Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BAMM.442S* **BAMM.442P**	Diffuse	24	0.027	SS PVC	.25	
IAMM.442S* **IAMM.442P**	Opposed	24	0.027	SS PVC	.25	
BAR.753S† **BAR.753P**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
IAR.753S† **IAR.753P**	Opposed	36	0.02 x 0.10	SS PVC	.25	
BAR.753SMRA* † **BAR.753PMRA**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
IAR.753SMRA† **IAR.753PMRA**	Opposed	36	0.02 x 0.10	SS PVC	.25	

* Available in 600°F version by adding suffix "M600" to model number

** Available in 900°F version by adding suffix "M900" to model number (some dimensions may change)

† M600 version uses aluminum instead of plastic insert

Standard Glass Fibers

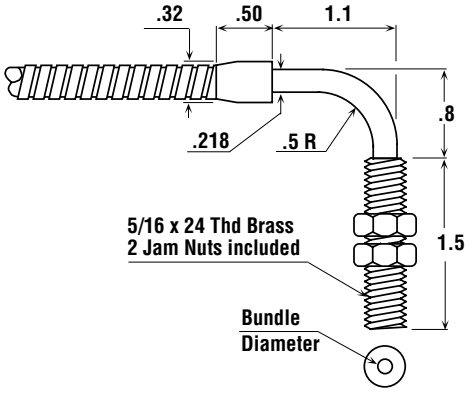
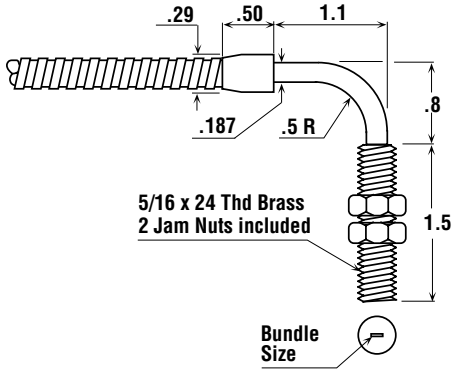
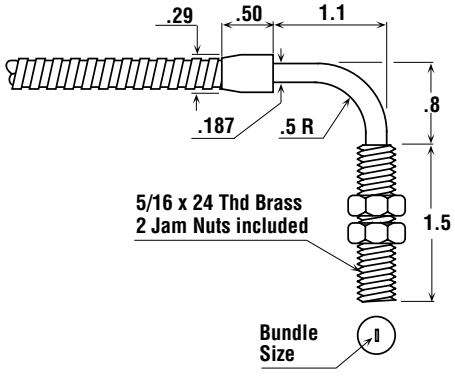
Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BAR.753SMTA* † **BAR.752SMTA*** †	Diffuse	36 24	0.02 x 0.10	SS	.25	
IAR.753SMTA* † **IAR.752SMTA*** †	Opposed	36 24	0.02 x 0.10	SS	.21	
BAR.753SMTAMRA* † **BAR.752SMTAMRA*** †	Diffuse	36 24	0.02 x 0.10	SS	.21	
IAR.753SMTAMRA* † **IAR.752SMTAMRA*** †	Opposed	36 24	0.02 x 0.10	SS	.21	
BAT23S* ** **BAT13P** **BAT13S**** **BAT23P**	Diffuse	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	
IAT23S* ** **IAT13P** **IAT13S*** ** **IAT23P**	Opposed	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	

* Available in 600°F version by adding suffix "M600" to model number

† M600 version uses aluminum instead of plastic insert

** Available in 900°F version by adding suffix "M900" to model number (some dimensions may change)

Standard Glass Fibers

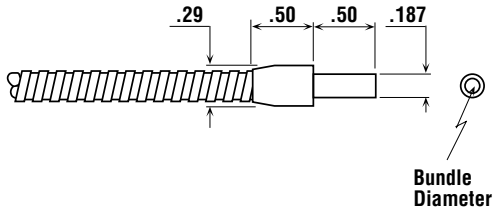
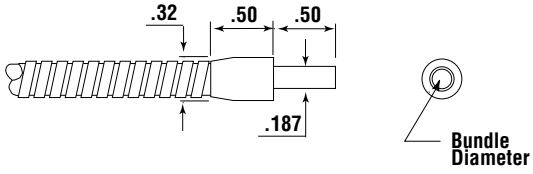
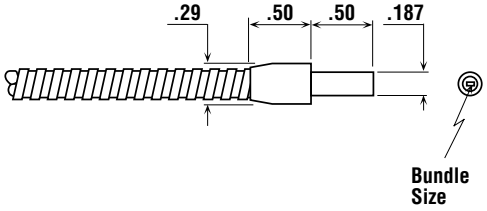
Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BAT2.53S* ** **BAT2.53P**	Diffuse	36	0.156	SS PVC	.30	
IAT2.53S* ** **IAT2.53P**	Opposed	36	0.156	SS PVC	.30	
BATR.753S* † BATR.753P	Diffuse	36	0.02 x 0.10	SS PVC	.25	
IATR.753S* † IATR.753P	Opposed	36	0.02 x 0.10	SS PVC	.25	
BATR.753SMRA* † BATR.753PMRA	Diffuse	36	0.02 x 0.10	SS PVC	.25	
IATR.753SMRA* † IATR.753PMRA	Opposed	36	0.02 x 0.10	SS PVC	.25	

* Available in 600°F version by adding suffix "M600" to model number

** Available in 900°F version by adding suffix "M900" to model number

† M600 version uses aluminum instead of plastic insert

Standard Glass Fibers

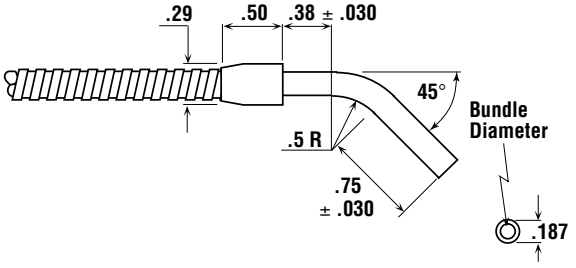
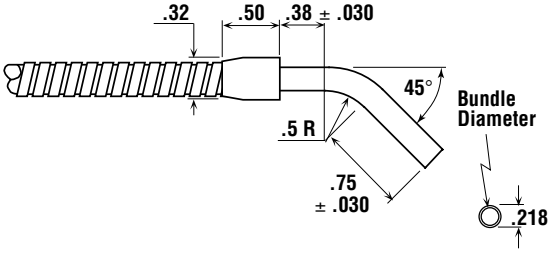
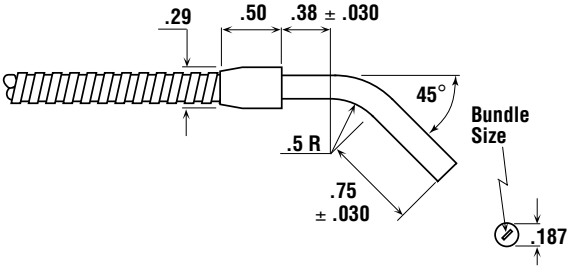
Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BF23S* ** **BF13S*** **BF13P** **BF23P**	Diffuse	36	**0.125** **0.062** **0.062** **0.125**	**SS** **SS** **PVC** **PVC**	.25	
IF23S* ** **IF13S*** **IF13P** **IF23P**	Opposed	36	**0.125** **0.062** **0.062** **0.125**	**SS** **SS** **PVC** **PVC**	.25	
BF2.53S* **BF2.53P**	Diffuse	36	0.156	SS PVC	.30	
IF2.53S* **IF2.53P**	Opposed	36	0.156	SS PVC	.30	
BFR.753P **BFR.753S*** †	Diffuse	36	0.02 x 0.10 0.02 x 0.10	PVC SS	.25	
IFR.753P **IFR.753S*** †	Opposed	36	0.02 x 0.10 0.02 x 0.10	PVC SS	.25	

* Available in 600°F version by adding suffix "M600" to model number

** Available in 900°F version by adding suffix "M900" to model number

† M600 version uses aluminum instead of plastic insert

Standard Glass Fibers

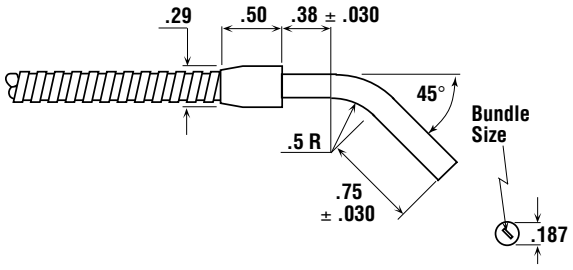
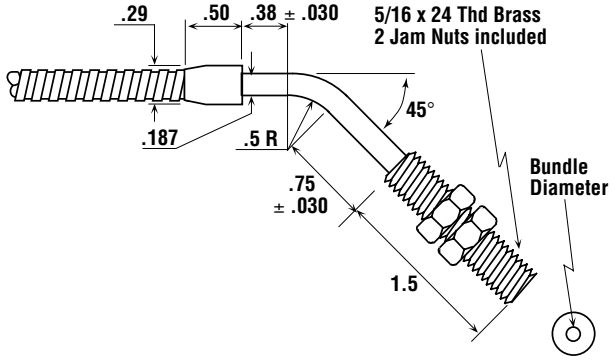
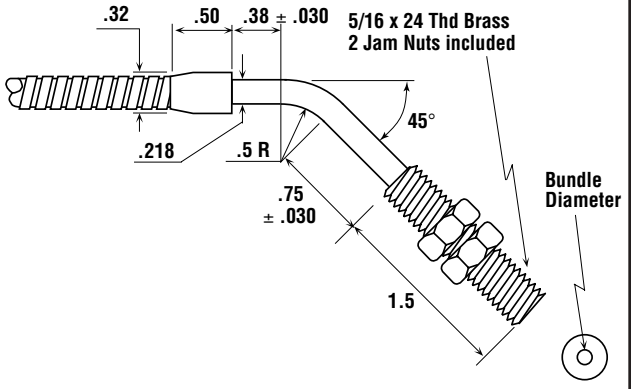
Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BHA23S*	Diffuse	36	0.125	SS	.25	
BHA13P			0.062	PVC		
BHA13S*			0.062	SS		
BHA23P			0.125	PVC		
IHA23S*	Opposed	36	0.125	SS	.25	
IHA13P			0.062	PVC		
IHA13S*			0.062	SS		
IHA23P			0.125	PVC		
BHA2.53S*	Diffuse	36	0.156	SS	.30	
BHA2.53P				PVC		
IHA2.53S*	Diffuse	36	0.156	SS	.30	
IHA2.53P				PVC		
BHAR.753S* †	Diffuse	36	0.02 x 0.10	SS	.25	
BHAR.753P				PVC		
IHAR.753S* †	Diffuse	36	0.02 x 0.100.02 x 0.10	SS	.25	
IHAR.753P				PVC		

* Available in 600°F version by adding suffix "M600" to model number

** Available in 900°F version by adding suffix "M900" to model number

† M600 version uses aluminum instead of plastic insert

Standard Glass Fibers

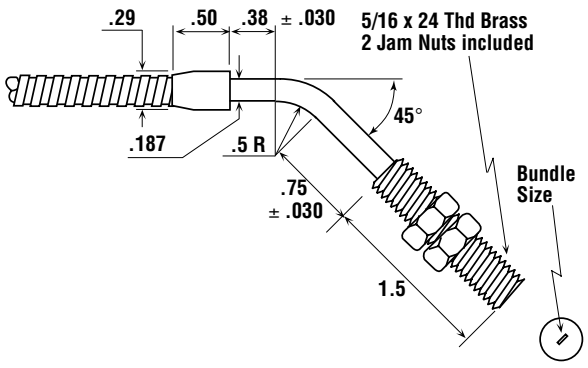
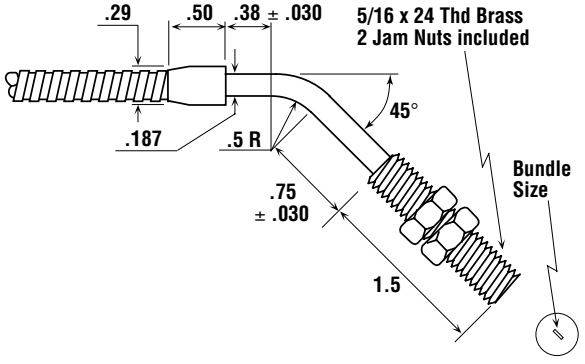
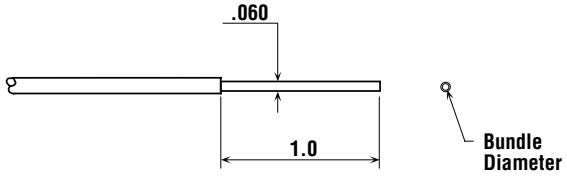
Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BHAR.753SMRA* † **BHAR.753PMRA**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
IHAR.753SMRA* † **IHAR.753PMRA**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
BHAT23S* **BHAT13P** **BHAT13S*** **BHAT23P**	Diffuse	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	
IHAT23S* **IHAT13P** **IHAT13S*** **IHAT23P**	Diffuse	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	
BHAT2.53S **BHAT2.53P**	Diffuse	36	0.156	SS PVC	.30	
IHAT2.53S* **IHAT2.53P**	Diffuse	36	0.156	SS PVC	.30	

* Available in 600°F version by adding suffix "M600" to model number

** Available in 900°F version by adding suffix "M900" to model number

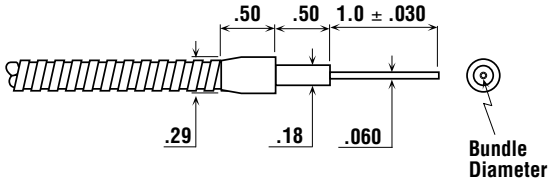
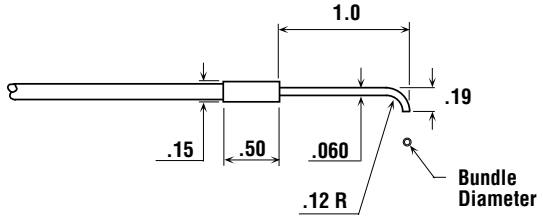
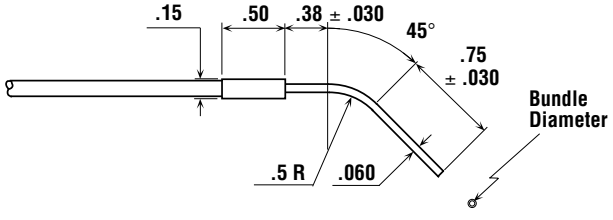
† M600 version uses aluminum instead of plastic insert

Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BHATR.753S*† **BHATR.753P**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
IHATR.753S*† **IHATR.753P**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
BHATR.753SMRA*† **BHATR.753PMRA**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
IHATR.753SMRA*† **IHATR.753PMRA**	Opposed	36	0.02 x 0.10	SS PVC	.25	
BM.752P **BM.753P**	Diffuse	24 36	0.046	PVC only	.09	
IM.752P **IM.753P**	Opposed	24 36	0.046	PVC only	.09	

* Available in 600°F version by adding suffix "M600" to model number
** Available in 900°F version by adding suffix "M900" to model number
† M600 version uses aluminum instead of plastic insert

Standard Glass Fibers

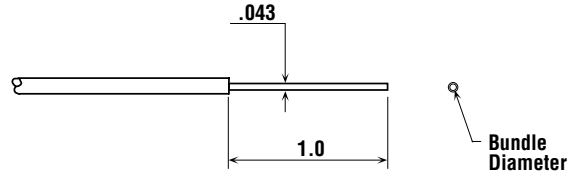
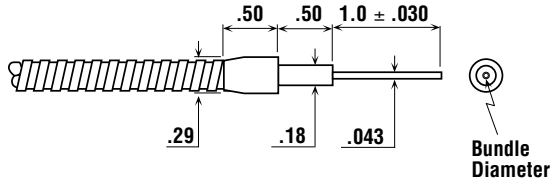
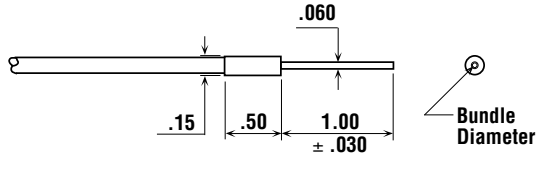
Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BM.752S* **BM.753S***	Diffuse	24 36	0.046	SS	.25	
IM.752S* **IM.753S***	Opposed	24 36	0.046 0.027	SS	.25	
BMAP.753P **BMAP.442P**[1]	Diffuse	36 24	0.046 0.027	PVC	.12	
([1] Probe diameter for this model is 0.043")						
IMAP.753P **IMAP.442P**[1]	Opposed	36 24	0.046 0.027	PVC	.12	
([1] Probe diameter for this model is 0.043")						
BMHAP.753P **BMHAP.442P**	Diffuse	36 24	0.046 0.027	PVC	.12	
IMHAP.753P **IMHAP.442P**	Opposed	36 24	0.046 0.027	PVC	.12	

* Available in 600°F version by adding suffix "M600" to model number

** Available in 900°F version by adding suffix "M900" to model number

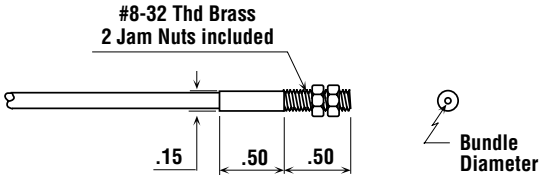
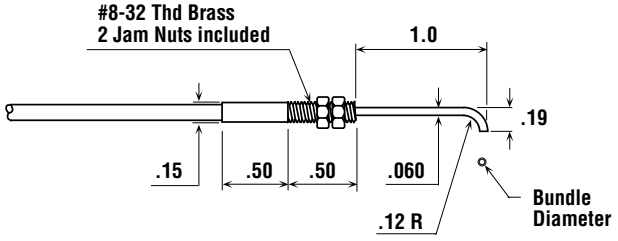
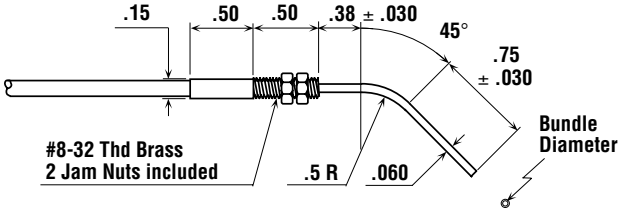
[1]Probe-style fibers may be modified for different probe lengths and angles

Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BMM.442P **BMM.443P**	Diffuse	24 36	0.027	PVC only	.09	
IMM.442P **IMM.443P**	Opposed	24 36	0.027	PVC	.09	
BMM.442S* **BMM.443S***	Diffuse	24 36	0.027	SS	.25	
IMM.442S* **IMM.443S***	Opposed	24 36	0.027	SS	.25	
BMP.753P **BMP.442P**	Diffuse	36 24	0.046 0.027	PVC	.12	
IMP.753P **IMP.442P**	Opposed	36 24	0.046 0.027	PVC	.12	

* Available in 600°F version by adding suffix “M600” to model number
** Available in 900°F version by adding suffix “M900” to model number

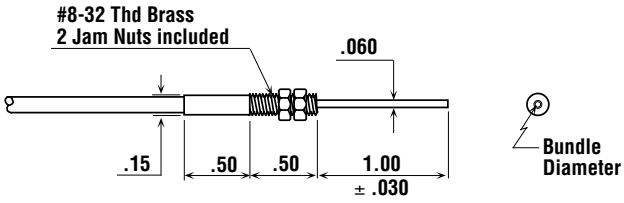
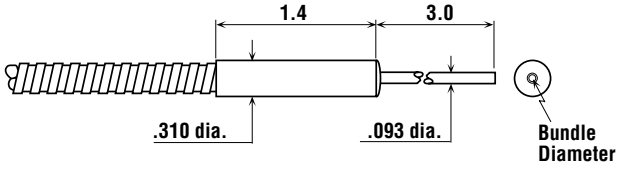
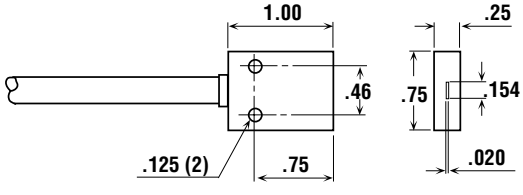
Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BMT.753P **BMT.442P**	Diffuse	36 24	0.046 0.027	PVC	.12	
IMT.753P **IMT.442P**	Opposed	36 24	0.046 0.027	PVC	.12	
BMTAP.753P **BMTAP.442P**[1] ([1]Probe diameter for this model is 0.043")	Diffuse	36 24	0.046 0.027	PVC	.12	
IMTAP.753P **IMTAP.442P**[1] ([1]Probe diameter for this model is 0.043")	Opposed	36 24	0.046 0.027	PVC	.12	
BMTHAP.753P **BMTHAP.442P**	Diffuse	36 24	0.046 0.027	PVC	.12	
IMTHAP.753P **IMTHAP.442P**	Opposed	36 24	0.046 0.027	PVC	.12	

* Available in 600°F version by adding suffix "M600" to model number
** Available in 900°F version by adding suffix "M900" to model number

[1]Probe-style fibers may be modified for different probe lengths and angles

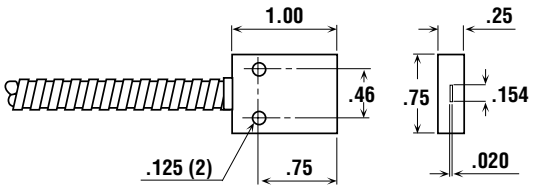
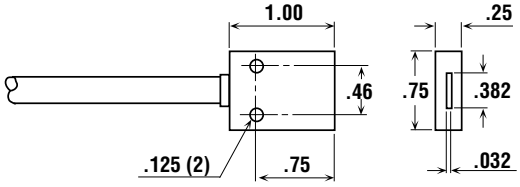
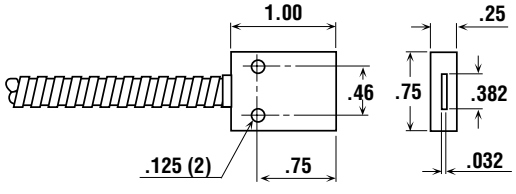
Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BMTP.753P **BMTP.442P**	Diffuse	36 24	0.046 0.027	PVC	.12	
IMTP.753P **IMTP.442P**	Opposed	36 24	0.046 0.027	PVC	.12	
BP13S* **BP12P** **BP12S*** **BP13P**	Diffuse	36 24 24 36	0.062	SS PVC SS PVC	.25	
Bendable probe sensing tip: R 6 mm (.24"), 12 mm (.47") min from either end						
IP13S* **IP12P** **IP12S*** **IP13P**	Opposed	36 24 24 36	0.062	SS PVC SS PVC	.25	
BR13P **BR12P**	Diffuse	36 24	0.020 x 0.154	PVC	.23	
IR13P **IR12P**	Opposed	36 24	0.020 x 0.154	PVC	.23	

* Available in 600°F version by adding suffix "M600" to model number (IR13S & IR23S)

** Available in 900°F version by adding suffix "M900" to model number

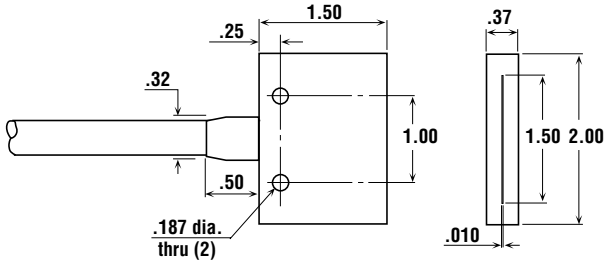
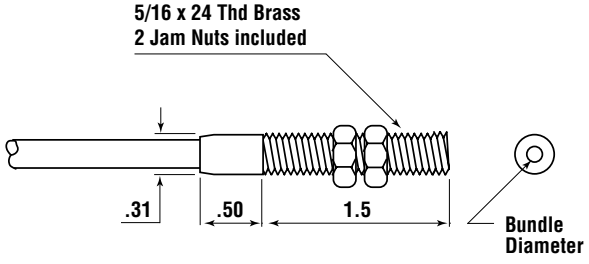
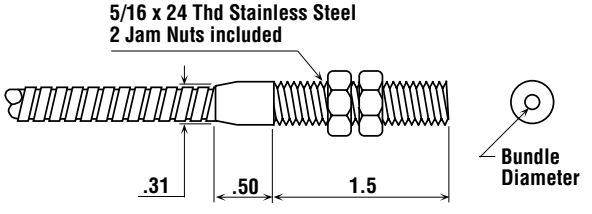
Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BR13S* **BR12S***	Diffuse	36 24	0.020 x 0.154	SS	.25	
IR13S* **IR12S***	Opposed	36 24	0.020 x 0.154	SS	.25	
BR23P **BR26P**	Diffuse	36 72	0.032 x 0.382	PVC	.23	
IR23P **IR26P**	Opposed	36 72	0.032 x 0.382	PVC	.23	
BR23S* **BR26S***	Diffuse	36 72	0.032 x 0.382	PVC	.25	
IR23S* **IR26S***	Opposed	36 72	0.032 x 0.382	PVC	.25	

* Available in 600°F version by adding suffix "M600" to model number (the plastic head on the BR13S and BR23S is replaced with an aluminum housing)

** Available in 900°F version by adding suffix "M900" to model number, brass threads are replaced with stainless steel with brass insert

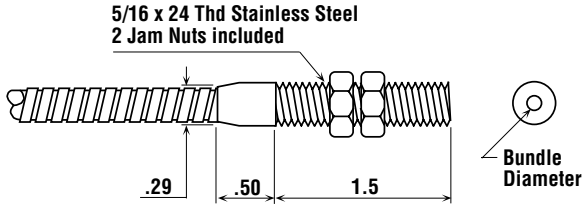
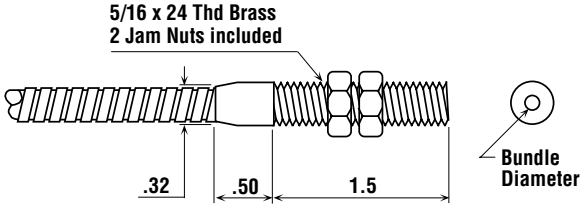
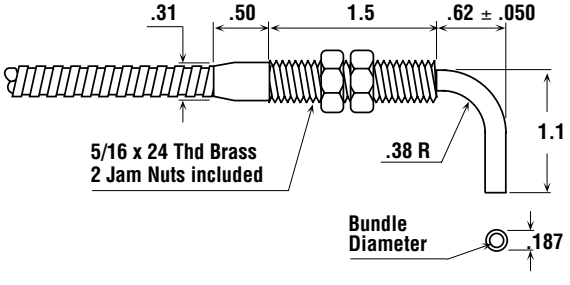
Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BR2.53P **BR2.56P** **BR2.53S*** **BR2.56S***	Diffuse	36 72 36 72	0.010 x 1.50	PVC PVC SS SS	.30	
IR2.53P **IR2.56P** **IR2.53S*** **IR2.56S***	Opposed	36 72 36 72	0.010 x 1.50	PVC PVC SS SS	.30	
BT13P **BT.752P** **BT13S*** **BT.752S*** **BT23S*** ** **BT23P** **BT26S*** **	Diffuse	36 24 36 24 36 36 72	0.062 0.046 0.062 0.046 0.125 0.125 0.125	PVC PVC SS SS SS PVC SS	.23 .23 .25 .25 .25 .25	
IT13P **IT.752P** **IT13S*** **IT.752S*** **IT23S*** ** **IT23P** **IT26S*** **	Opposed	36 24 36 24 36 36 72	0.046 0.046 0.062 0.046 0.125 0.125 0.125	PVC PVC SS SS SS PVC SS	.23 .23 .25 .25 .25 .25	
BT23SMSS* **BT23PMSS**	Diffuse	36	0.125	SS PVC	.25	
IT23SMSS* **IT23PMSS**	Opposed	36	0.125	SS PVC	.25	

* Available in 600°F version by adding suffix “M600” to model number

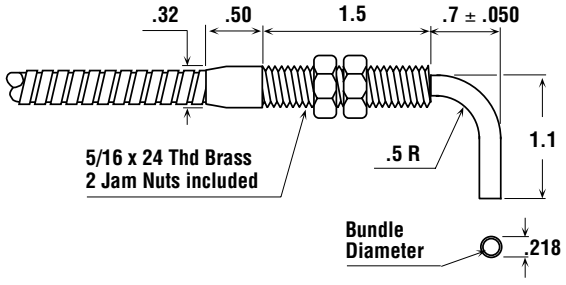
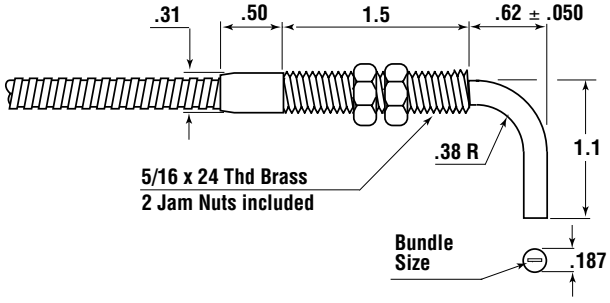
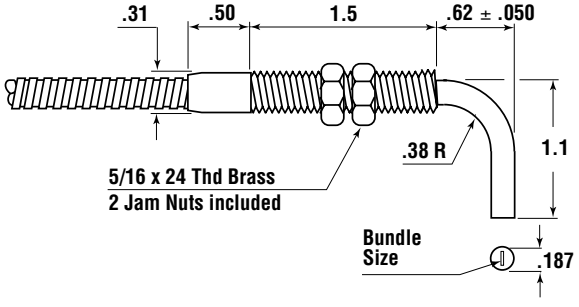
** Available in 900°F version by adding suffix “M900” to model number

Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BT23SM900 **BT26SM900** **BT210SM900**	Diffuse	36 72 120	0.125	SS	.25	
IT23SM900 **IT26SM900** **IT210SM900**	Opposed	36 72 120	0.125	SS	.25	
BT2.53S* **BT2.53P**	Diffuse	36	0.156	SS PVC	.30	
IT2.53S* **IT2.53P**	Opposed	36	0.156	SS PVC	.30	
BTA23S* ** **BTA13P** **BTA13S*** **BTA23P**	Diffuse	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	
1.1" dimension changes with M900 (see p. 708)						
ITA23S* ** †† **ITA13P** **ITA13S*** **ITA23P**	Opposed	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	

* Available in 600°F version by adding suffix "M600" to model number
** Available in 900°F version by adding suffix "M900" to model number
† M600 version uses aluminum instead of plastic insert
†† M900 uses stainless steel threads

Standard Glass Fibers

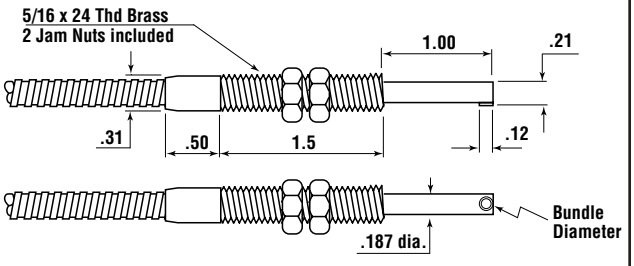
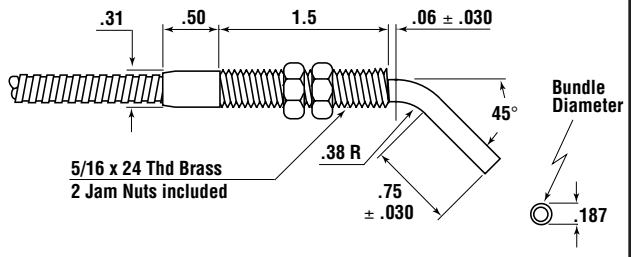
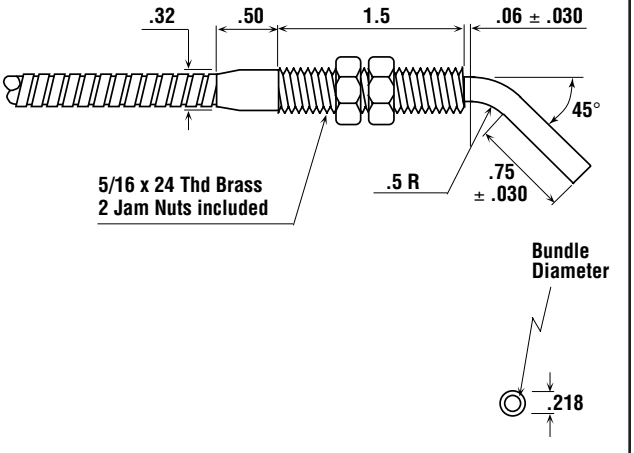
Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BTA2.53S* **BTA2.53P**	Diffuse	36	0.156	SS PVC	.30	
ITA2.53S* **ITA2.53P**	Opposed	36	0.156	SS PVC	.30	
BTAR.753S* † **BTAR.753P**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
ITAR.753S* † **ITAR.753P**	Opposed	36	0.02 x 0.10	SS PVC	.25	
BTAR.753SMRA* † **BTAR.753PMRA**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
ITAR.753SMRA* † **ITAR.753PMRA**	Opposed	36	0.02 x 0.10	SS PVC	.25	

* Available in 600°F version by adding suffix "M600" to model number

** Available in 900°F version by adding suffix "M900" to model number

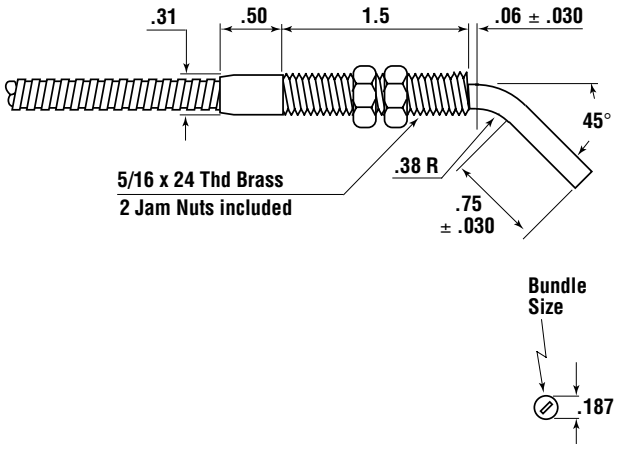
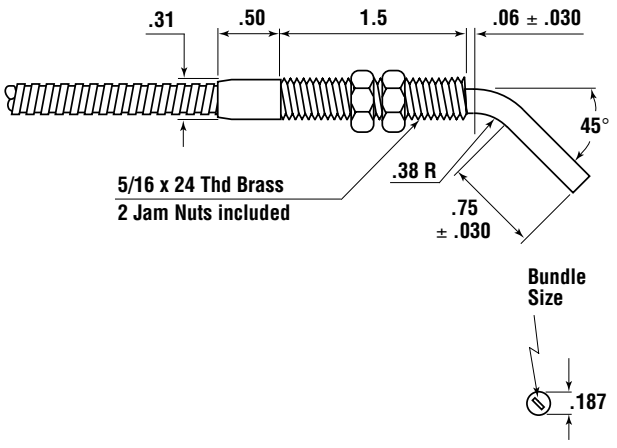
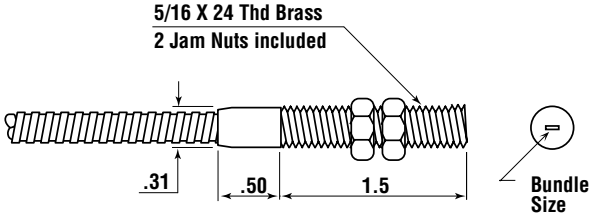
† M600 version uses aluminum instead of plastic insert

Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BTETA1.53S* BTETA.753S* BTETA13S*	Diffuse	36	0.090 0.046 0.062	SS	.25	
ITETA1.53S* ITETA.753S* ITETA13S*	Opposed	36	0.090 0.046 0.062	SS	.25	
BTHA23S* BTHA13P BTHA13S* BTHA23P	Diffuse	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	
ITHA23S* ITHA13P ITHA13S* ITHA23P	Opposed	36	0.125 0.062 0.062 0.125	SS PVC SS PVC	.25	
BTHA2.53S* BTHA2.53P	Diffuse	36	0.156	SS PVC	.30	
ITHA2.53S* ITHA2.53P	Opposed	36	0.156	SS PVC	.30	

* Available in 600°F version by adding suffix "M600" to model number
** Available in 900°F version by adding suffix "M900" to model number

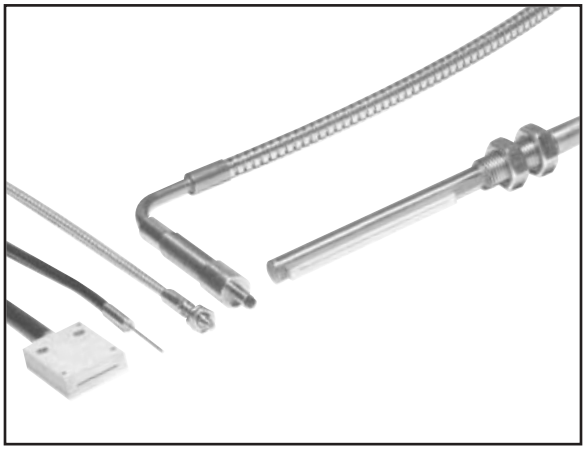
Standard Glass Fibers

Model	Sensing Mode	Final Assembly Lgth (in)	Bundle Size or Dia. (in)	Sheath Material	Sheath Dia. (in)	Sensing End Tip Dimensions (in)
BTHAR.753S* † **BTHAR.753P**	Diffuse	36	0.02 x 0.10	SS PVC	SS PVC	
ITHAR.753S* † **ITHAR.753P**	Opposed	36	0.02 x 0.10	SS PVC	SS PVC	
BTHAR.753SMRA* † **BTHAR.753PMRA**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
ITHAR.753SMRA* † **ITHAR.753PMRA**	Opposed	36	0.02 x 0.10	SS PVC	.25	
BTR.753S* † **BTR.753P**	Diffuse	36	0.02 x 0.10	SS PVC	.25	
ITR.753S* † **ITR.753P**	Opposed	36	0.02 x 0.10	SS PVC	.25	

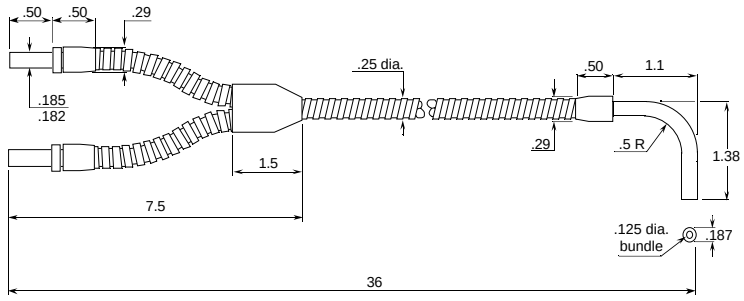
[1]Probe-style fibers may be modified for different probe lengths and angles

† M600 version uses aluminum instead of plastic insert

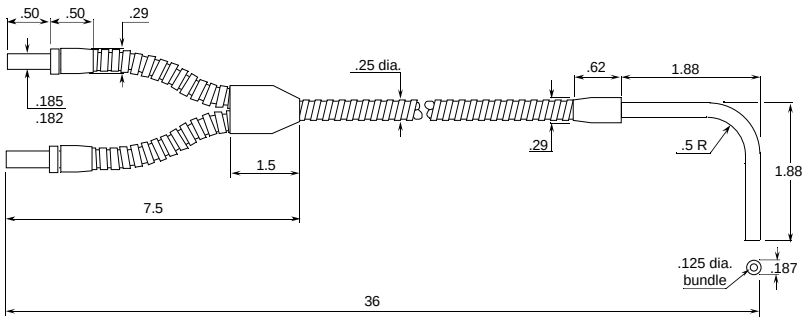
Custom Glass Fibers



Banner would like the opportunity to solve your most challenging sensing applications, using custom-designed glass fiber optics. Following are just a few examples of custom glass fiber optic assemblies which have been produced, to date. Contact your local sales engineer or our factory applications experts to discuss the details of your application requirements.

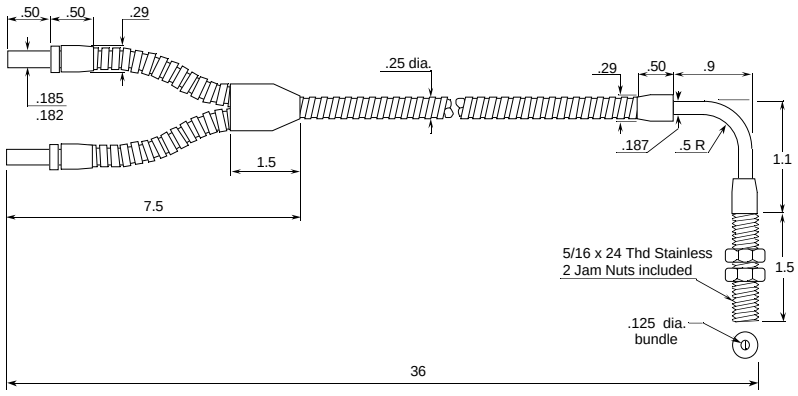
Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
BA23SM1.38	36	0.125	SS	

This is a modified version of standard model BA23S. The length of the ferrule after the angle is extended from 0.8" to 1.38". This dimension can be made longer or can be made as short as 0.5". The smallest bend radius for the $^{3}/_{16}$" stainless steel tubing is $^{3}/_{8}$". The 1.1" dimension (before the angle) can also be modified.

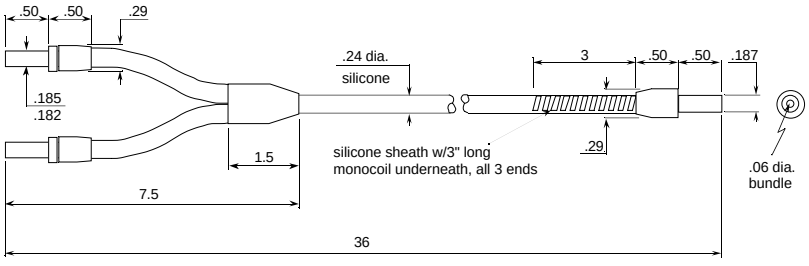
BA23SM1.9SQM900	36	0.125	SS	

This modification of the BA23S is for high temperature environments, up to 900° F. The angle end does not contain epoxy, which might break down at high temperatures. The high temperature construction of the scanning end requires 1.88" (or more) after the angle. The length of the tubing (before the angle, 1.88") can be made longer or modified to as short as 1.1". The shrink junction is made of PVC and should not be exposed to temperatures above 220°F.

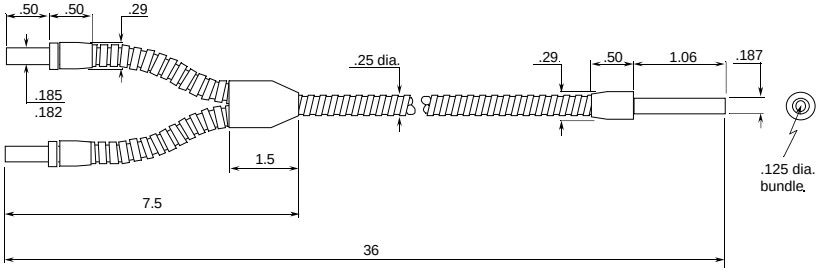
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
BAT23SM900	36	0.125	SS	

The BAT23SM900 is the 900° F version of standard model BAT23S. The high temperature version requires a mechanical modification to eliminate the use of epoxy on the sensing end. The shrink junction is made of PVC tubing and should not be exposed to temperatures above 220° F. The material used for the threaded portion of the assembly is changed from brass to stainless steel, with brass insert.

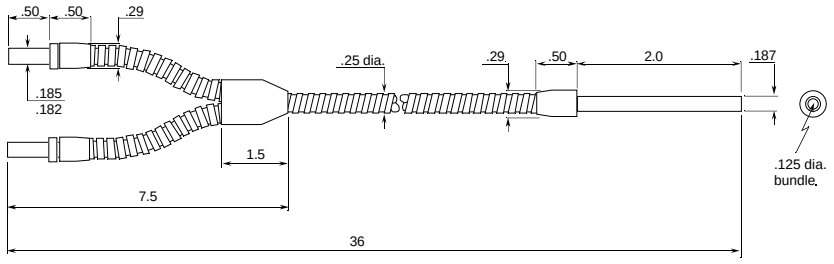
BF13LMSRE	36	0.125	Silicone	

Silicone rubber sheathing is used for this modification of standard model BF13S. The non-conductive rubber is very soft and flexible. A short length (3") of interlocking stainless steel is used inside the silicone sheathing on all three ends to protect the glass bundle. Silicone sheathing is used for its electrical insulating properties.

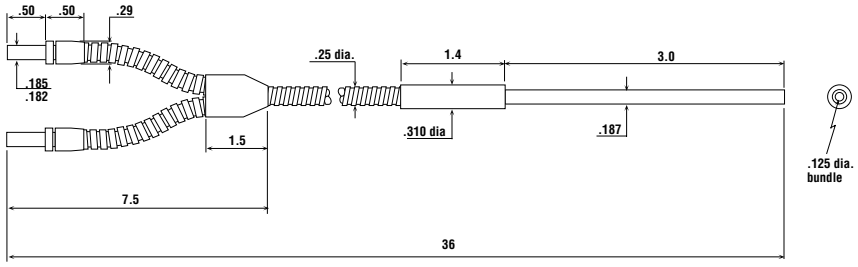
BF23SM1.06	36	0.125	SS	

This special assembly is an example of a modification to the sensing end ferrule of standard model BF23S. Here, the ferrule length is 1.06". A ferruled end tip can be ordered in nearly any length. The ferrule diameter can also be modified. This style of end tip is hard stainless steel, and is not bendable.

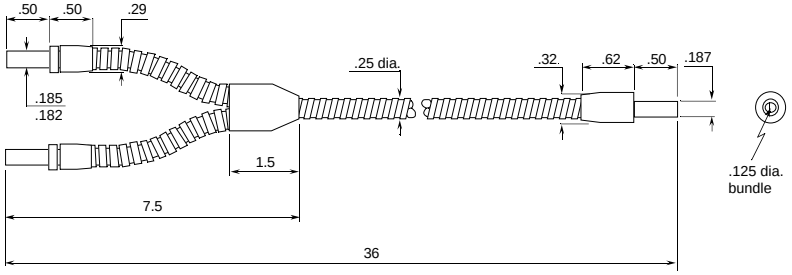
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
BF23SM2	36	0.125	SS	

This modification of the ferruled end tip extends for a total length of two inches. A ferrule-style fiber is typically mounted through a 3/16" diameter hole, using a setscrew to secure it. By using a long ferruled tip, easy adjustment of sensing distance is possible by sliding the ferrule in and out through the mounting hole.

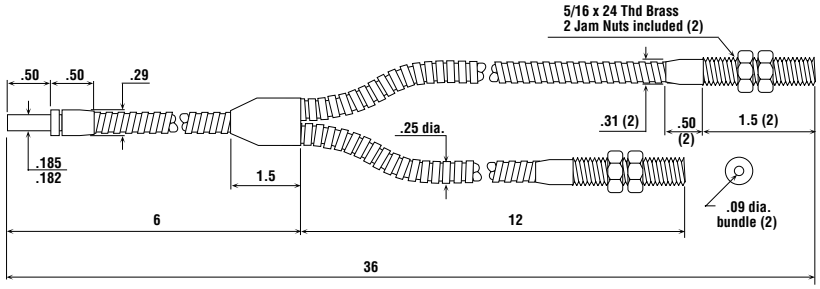
BF23SM3FMB	36	0.125	SS	

This BF23S with a three inch ferrule also has a mounting "bullet" found on probe style fibers. This allows use of the FMB-1 mounting bracket.

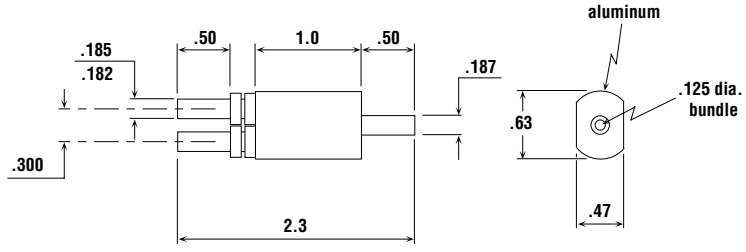
BF23SM900	36	0.125	SS	

This modification of standard model BF23S is for high temperature environments. The maximum allowable temperature for the standard fiber is 249° C (480° F). This modification allows the sensing end tip to survive in temperatures up to 900° F (480° C). The fiber bundle is randomly mixed at the sensing end tip. Specify a longer cable length if necessary.

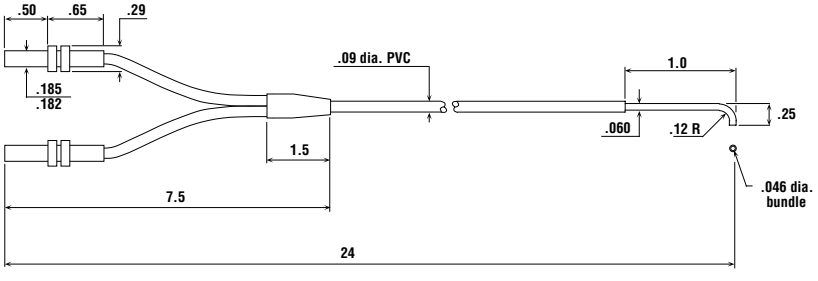
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
BF23SMTTULB	36	0.090	SS	

Most bifurcated fiber assemblies are used in the diffuse (proximity) sensing mode, but this one is used (in pairs) in the opposed mode. The common end of one cable connects to an emitter, and the common end of the other cable, to a receiver. The two opposed beams created with the branched ends must both be broken in order to obtain an output from the sensor ("dark-AND" logic). Threaded ends are used to extend the opposed sensing range with addition of lenses L9 or L16F.

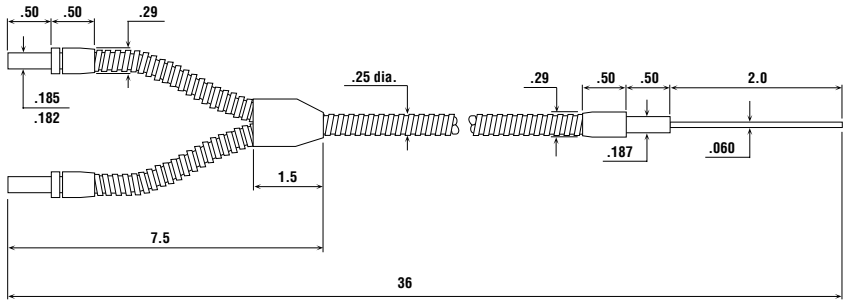
BF2M300	2.3	0.125	SS and Aluminum	

Most fiber optic assemblies use flexible sheathing to allow the sensing end to reach areas which are inaccessible to a larger self-contained photoelectric sensor. This assembly is a block which is used with MINI-BEAM fiber optic sensors. This fiber was designed for systems which require the sensor to be mounted on a movable arm. When a part is in place, the sensor moves to the inspection point. This type of assembly eliminates breakage caused by flexing of the sheathing of a standard fiber.

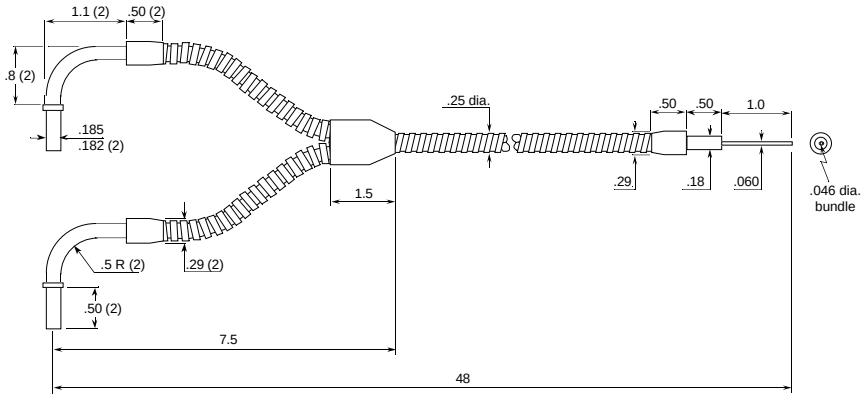
BM.752PMA.25	24	0.046	PVC	

This Bifurcated Miniature Probe with a Modified Angle is used in applications where space is limited. It can be built either as a bifurcated (shown) or an individual fiber (IM.752PMA.25). The PVC sheathing used on miniature probe style fibers does not have a monocoil reinforcing wire. Care should be taken not to exceed the 12 mm (0.5") minimum bend radius of this small sheathing.

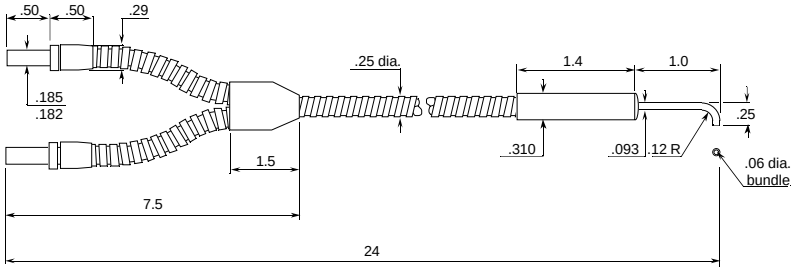
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
BM.753SM2	36	0.046	SS	

Standard model BM.752S is modified to create this special assembly. The overall length is extended to 36" and the miniature sensing end is two inches long. Miniature ends are made of stainless steel and are not bendable. We can pre-bend the tubing before assembling the fiber in order to create a particular design. Multiple bends in the sensing end can also be made.

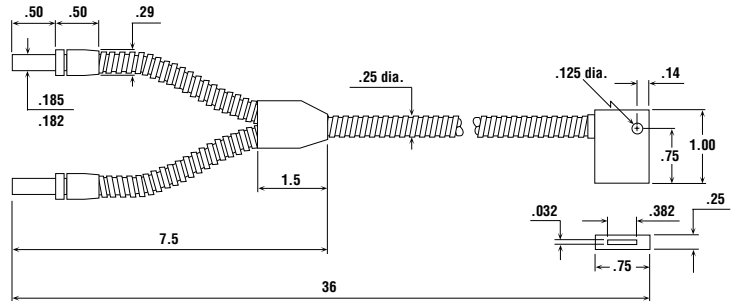
BM.754SMAMA	48	0.046	SS	

Fiberoptic assemblies may be designed to exactly fit a space-restricted area. This application required the fiber to exit the photoelectric sensor and turn a sharp right angle. The minimum bend radius of the sheathing of a standard fiber assembly would have been exceeded in this application. This modification can be made to virtually any standard fiberoptic assembly.

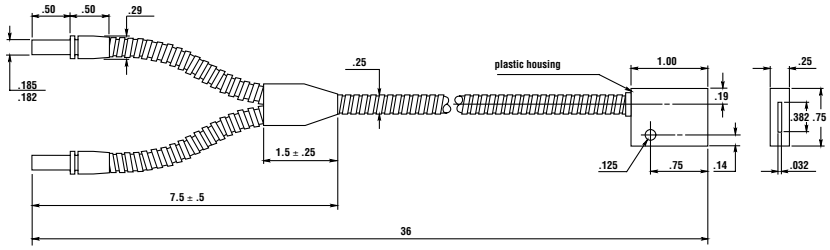
BP12SMA1X.25	24	0.060	SS	

This modification of standard model BP12S shows the minimum bend radius of the 0.09" diameter tubing used on standard probe fibers. The 1/4" distance after the angle is the minimum allowable for a true 90° angle. Standard probe length is three inches, with the middle two inches bendable. One half inch on each end of the probe is not bendable due to the optical epoxy used. The one inch probe on model BP12SMA1X.25 is not bendable.

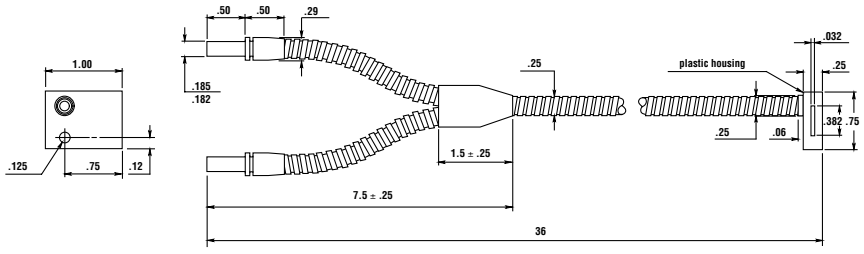
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
BR23SMRA	36	0.125	SS	

Model BR23SMRA is a cable exit modification of standard model BR23S. This assembly was designed for a register mark sensing application where there was very limited space for the sensor. The fiber optic sensing end could not be close to the surface of the web. Therefore, a large rectangular fiber bundle was required. The fiber optic cable exits from the side of the plastic housing. Note that one of the two mounting holes is lost due to this modification.

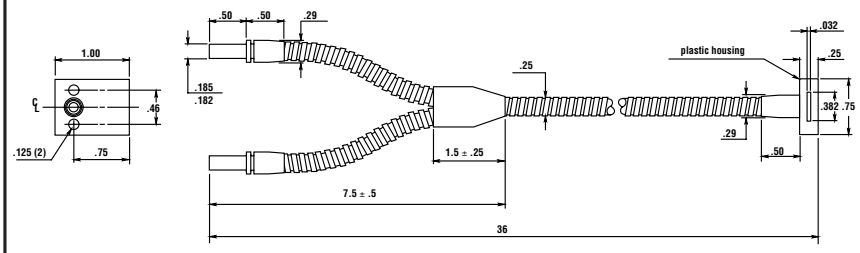
BR23SMCCE	36	0.125	SS	

Model BR23SMCCE is a cable exit modification to BR23S and has a Corner Cable Exit. This modification is also available on individual fiber optic assemblies, and fibers with a smaller rectangular bundle size. This model loses one of the two available mounting holes due to its modification.

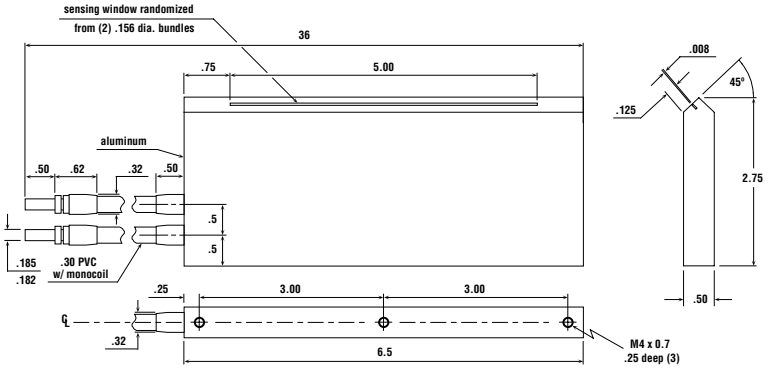
BR23SMCSE	36	0.125	SS	

Model BR23SMCSE is a cable exit modification to BR23S and has a Cable Side Exit. This modification is also available on individual fiber optic assemblies, and fibers with a smaller rectangular bundle size. This model loses one of the two available mounting holes due to its modification.

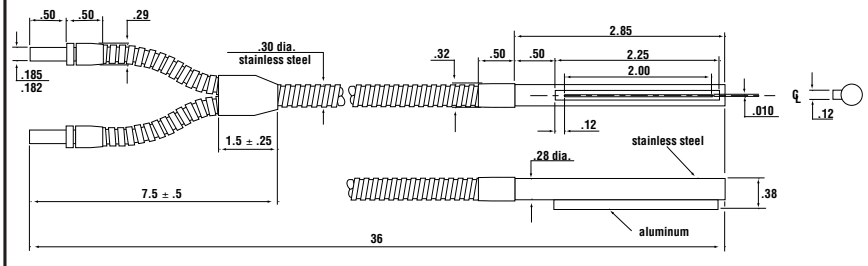
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
BR23SMCSC	36	0.125	SS	

Model BR23SMCSC is a cable exit modification to BR23S and has a Cable Side Center. This modification is also available on individual fiber optic assemblies, and fibers with a smaller rectangular bundle size.

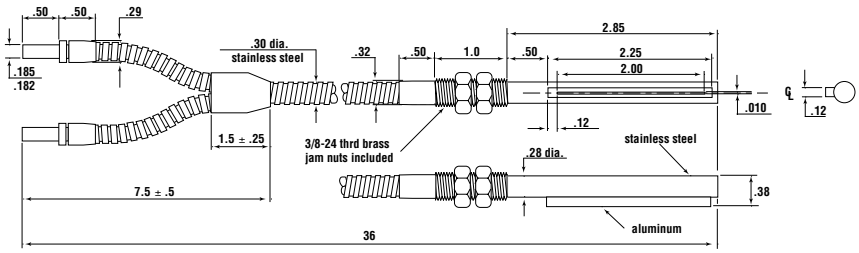
BR53PM5X.008	36	0.156 (2)	PVC	

This special rectangular fiber assembly uses the maximum bundle size (0.156" diameter) in each ferrule to obtain this large sensing area. The assembly requires the use of one photoelectric sensor to cover the five inch wide window. The fiber optic block is beveled on the end where the fiber slot is located. The object being detected in this application is folded paper which is placed on top of this fiber assembly. This configuration is used to allow the fibers to "look" at the object being sensed at a perpendicular angle.

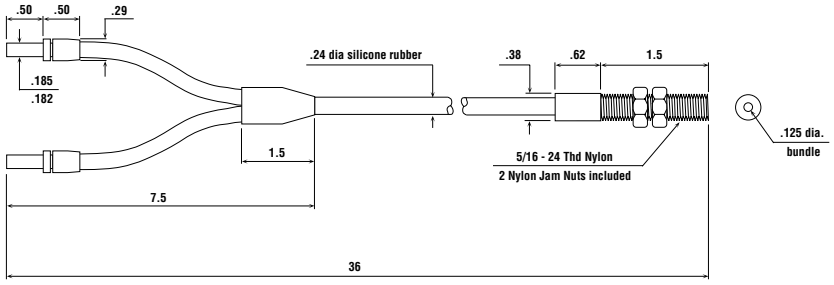
BRSE2.53S	36	0.156	SS	

The model BRSE2.53S Bifurcated Rectangular Side Exit assembly is used in applications where space is limited. This assembly can be built as a bifurcated fiber assembly (shown above) or as an individual fiber assembly (model IRSE2.53S).

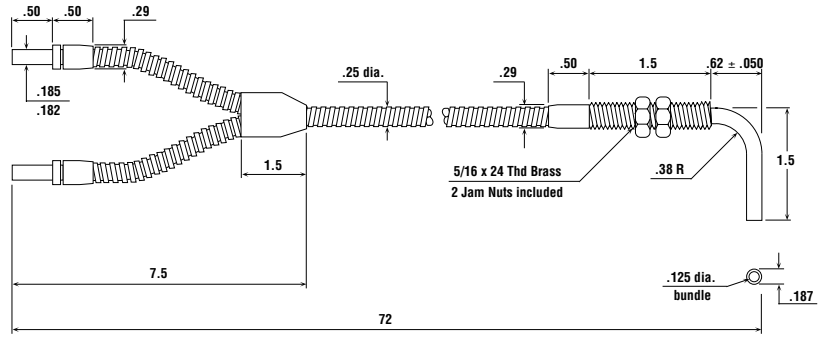
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
BTRSE2.53S	36	0.156	SS	

The model BTRSE2.53S is a threaded version of the the model BRSE2.53S (previous page).

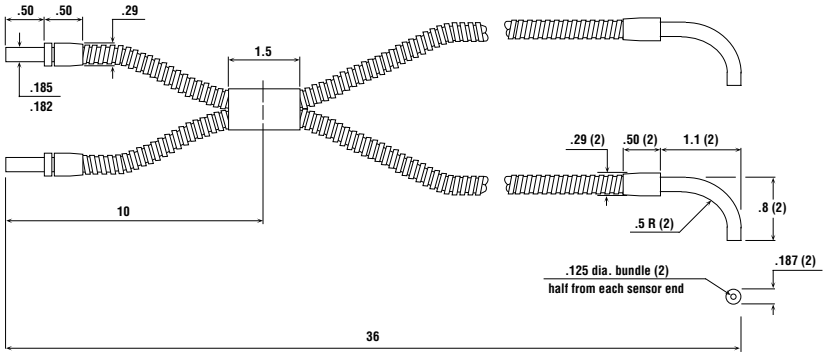
BT23LMNC	36	0.125	Silicone	

The BT23LMNC has basically the same configuration as a standard BT23P, with a few exceptions to conform to a particular application need. The BT23P has a steel reinforcing coil, which has been eliminated in the BT23LMNC, and the PVC sheath has been replaced with a sheath of silicone rubber. The threaded brass end tip has been replaced with a nylon tip. It is for use in a high-voltage area, where the fiber must be of a non-conductive construction. This option can be applied to most standard fiber bundles, for similar environments.

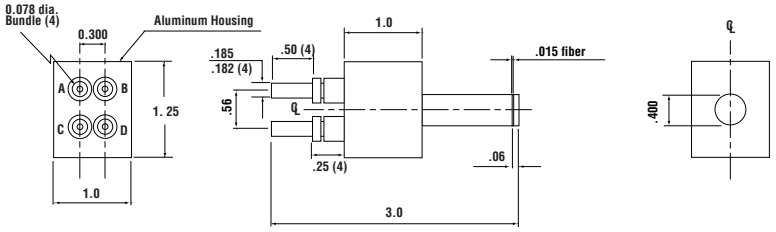
BTA26SM900	72	0.125	SS	

This modification of standard model BTA23S is used for high temperature applications. The maximum temperature limit of this special fiber assembly is 900° F (+480° C). The threaded portion of the fiber is changed from brass (on the standard model) to stainless steel (on this special). Stainless steel tubing has brass insert. The overall length has also been changed from 36 to 72".

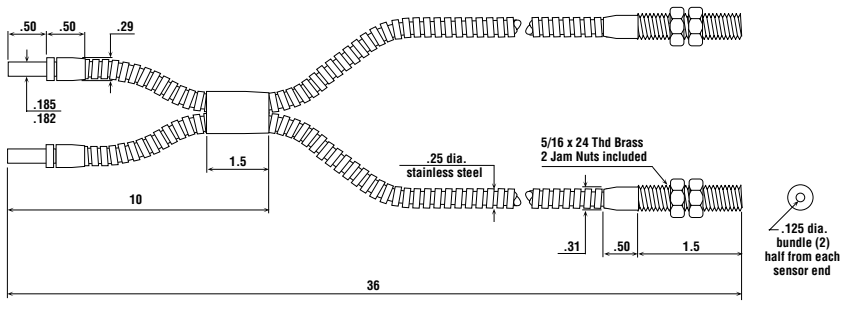
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
DBA23S	36	0.125	SS	

This Double Bifurcated Angle fiber assembly is used for sensing at two locations with one photoelectric sensor. Since the fiber is used in the diffuse mode of sensing, an object is detected if light is returned to either end of the fiber. When the photoelectric sensor is programmed for light operate, a "light-OR" logic function is established. In dark operate, a "dark-AND" logic function results.

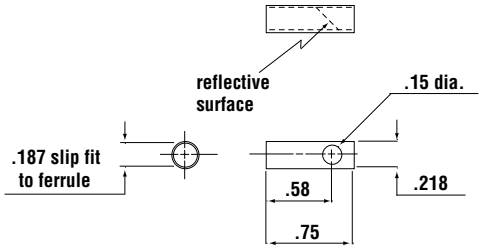
DBRC2.5M300	3	0.156	Aluminum	

This Double Bifurcated Radial Circle fiber assembly is used to inspect the inside of a cylinder wall to detect the absence of a black coating. The M300 suffix indicates that the assembly is designed for use with SM312 Series sensors. The circular bundle is split between two model SM312FV sensors, which (in this instance) provide a visible light source that yields a higher contrast ratio than would an infrared source in color sensing applications.

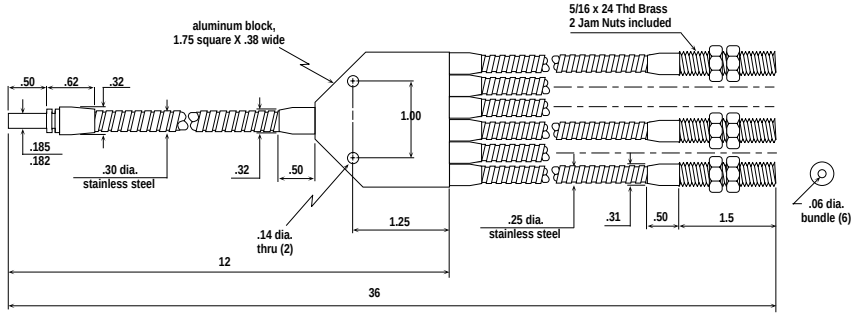
DBT23S	36	0.125	SS	

This Double Bifurcated Threaded fiber optic cable is a popular special assembly. Mounting the sensing ends is easy using the jam nuts. Each sensing end has a 1/8" diameter fiber bundle and performance equal to a single bifurcated assembly, like model BT23S. If the photoelectric sensor is programmed for light operate, a "light-OR" logic function results.

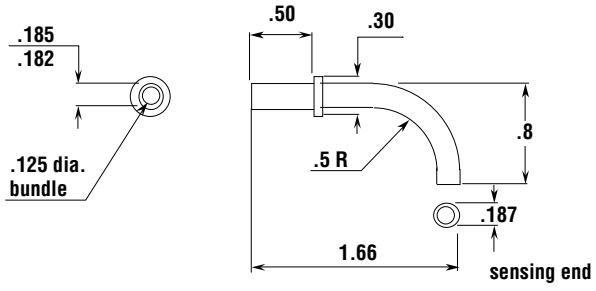
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
FARA	0.75	N/A	SS	

This special fiber attachment is typically used with model IF23S fibers to "bend" the light at a right angle to the length of the fiber ferrule. It is also used with model BF23SM2 when model BA1.53SMTA is too large in diameter to fit in the allocated space. The FARA slips over the ferrule and is held in place with an adhesive, (not supplied). The highly-polished reflective surface of the FARA is recessed in the stainless tube. Therefore, this assembly should not be used in a dirty environment. Excess gain is reduced 50% when using the model FARA.

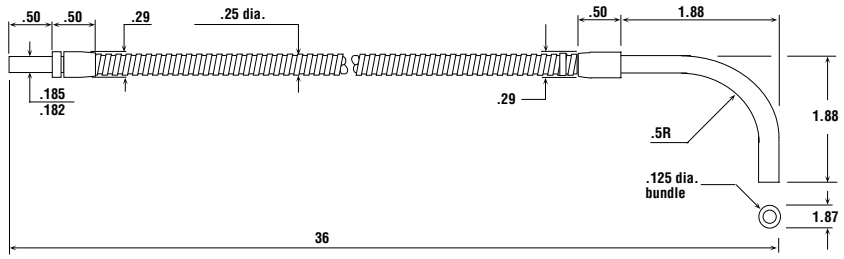
Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
HF2.53SMTT	36	0.062 (6)	SS	

The HF2.53SMTT is used in pairs (in the opposed mode) as a six-input “AND” gate, where all six beams must be broken before the sensor responds. The fiber bundle diameter at the photoelectric sensor end is the largest (0.156" diameter) available. At each of the sensing ends, the bundle diameter is 0.06". When determining the maximum sensing distance, use the excess gain curve for model IT13S. The number of legs on the fiber is not limited to six, and can be of different lengths. The end tip design may also be modified.

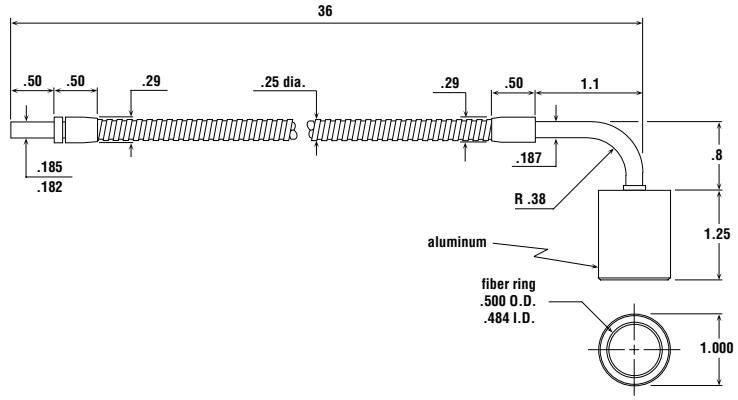
Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
IA2.15MSS	1.66	0.125	SS	

This special fiber assembly is the shortest possible modification to model IA23S. The entire ferrule is stainless steel and is not bendable. It is used in pairs with FOF-400 fiber optic fittings and LR400/PT400 sensors where space limitations prevent the use of right angle sensors. They may also be used with other sensors to provide various degrees of convergent-proximity mode sensing. The bundle diameter and overall length can be modified for your application.

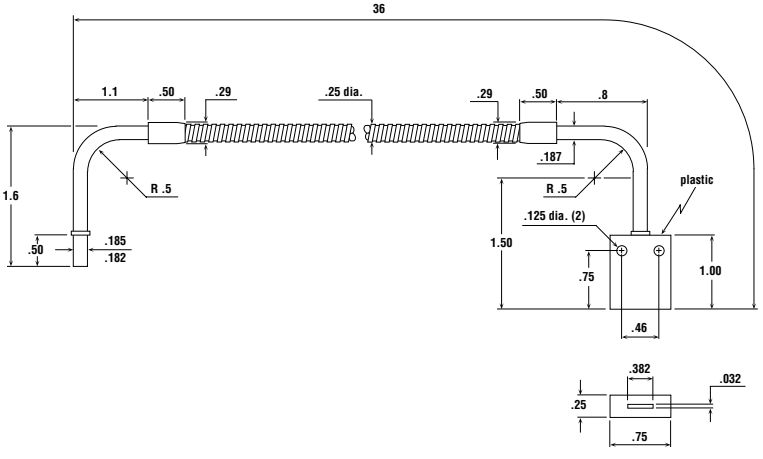
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
IA23SM1.9SQM900	36	0.125	SS	

This fiberoptic assembly is an individual fiber version of model BA23SM1.9SQM900. This assembly is modified for high temperature applications, up to 900° F (480°C). They are used in pairs in the opposed mode, and usually with high powered infrared sensors. A typical application is part presence detection in small kilns and ovens. One IA23SM1.9SQM900 may also be used with model SBAR1GHF to sense hot metal or hot glass.

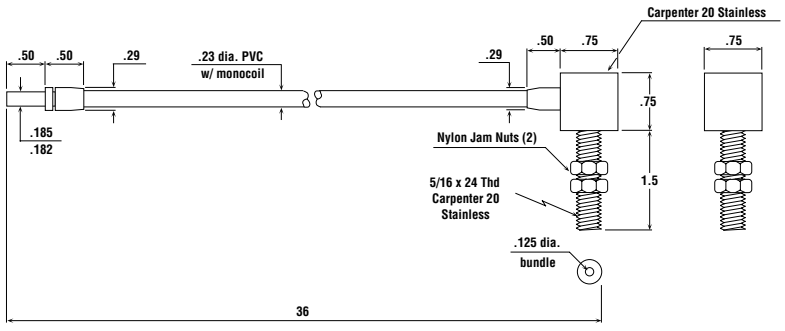
IAC23SM.500	36	0.125	SS	

This Individual Axial Circle fiber was designed for a special application to inspect the entire circumference of small opaque discs for chips and cracks. The disc is stopped momentarily between an opposed pair of fibers at the inspection station. The size of the fiber circle is slightly less than that of the disc. If no light passes to the receiver, the disc is accepted and advanced to the assembly area. This circular style of fiber can be made in a wide variety of diameters and line widths. The only restriction is the maximum bundle size per sensor ferrule (0.156" diameter).

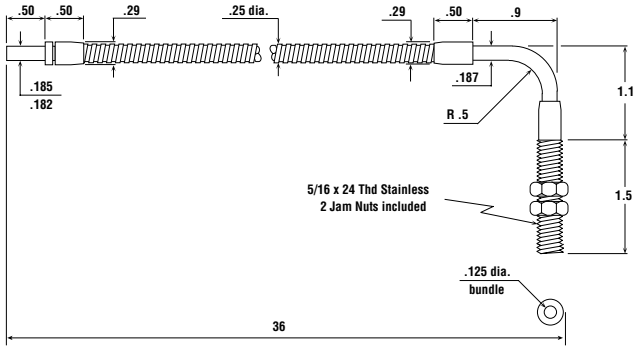
IAR23SMA	36	0.125	SS	

This modification of standard model IR23S has an angle at both ends. Both modifications were due to space limitations. The angle of the stainless steel tubing can be modified to suit a particular application. This type of modification can also be made to larger rectangular fibers like models IR2.53S and BR2.53S.

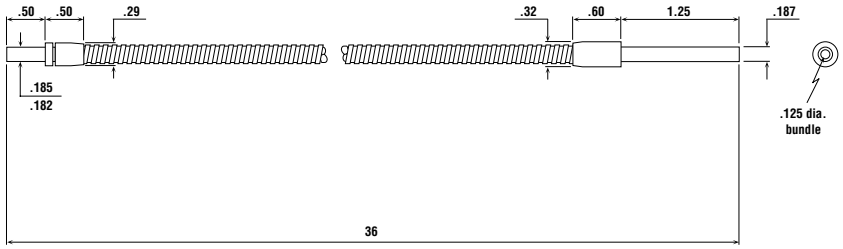
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
IAT23PMC20	36	0.125	PVC	

This special purpose fiber optic assembly is used in the manufacture of automobile batteries. It is subjected to continuous splash of electrolyte (acid). Carpenter 20 grade stainless steel is used for the threaded portion and for the right-angle block to withstand the acid environment. Modifications of the length, sheathing, and sensing end tip material are possible on this model.

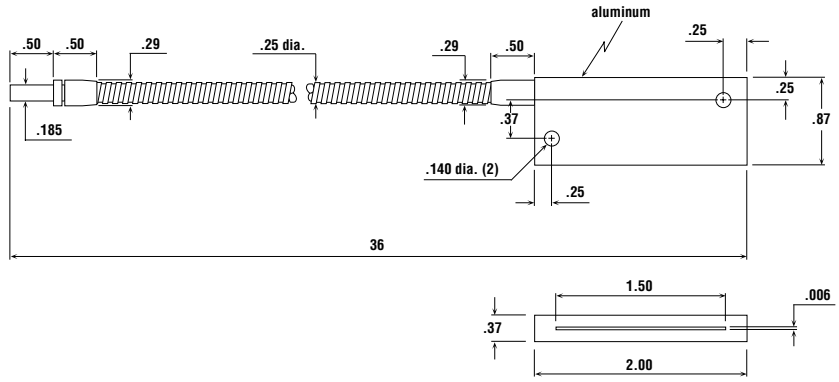
IAT23SM900	36	0.125	SS	

Model IAT23S is modified for high temperature operation to make this special fiber. Optical grade epoxy is eliminated at the sensing end of the fiber so that it can operate at up to 900° F (480° C). This change in manufacturing requires a slight dimensional change in the length of the angled portion of the sensing end. The material for the threaded portion is changed from brass to stainless steel, with brass insert.

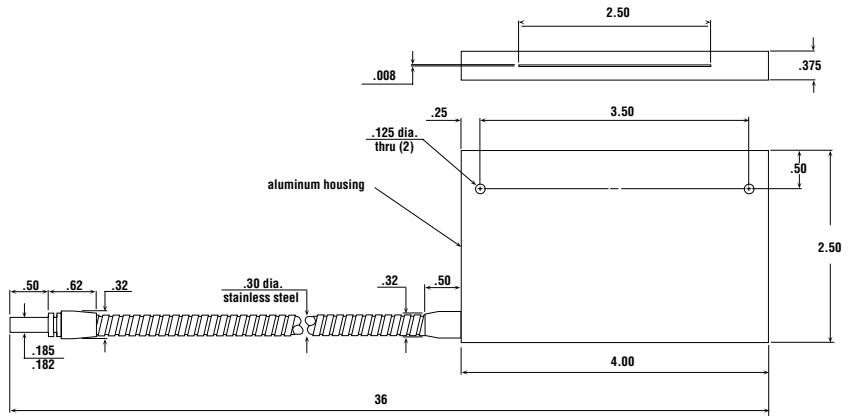
IF23SM900	36	0.125	SS	

This fiber optic assembly is a high temperature modification of standard model IF23S. Suffix "M900" stands for modified for 900° F (480° C). Dimensional differences include crimp collar diameter and ferrule length. These changes are necessary for manufacturing of the end tip without epoxy. Ferrule length can be extended like model BF23SM2.

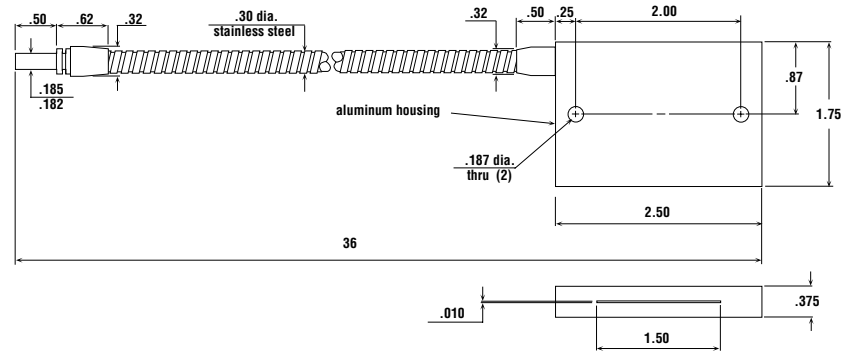
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
IR1.73SMSE.006	36	0.106	SS	

Model IR2.53S was too large to for an application requiring a long, thin rectangular fiber window. A machined housing was needed to fit the space allocated for the sensing end. The rectangular window is modified to only 0.006" wide, the smallest available. The mounting holes also had to be moved to allow the cable to exit from the side of the housing. The 1.5" length of the fiber window cannot be made longer in this housing style, but the window width can increase up to 0.013".

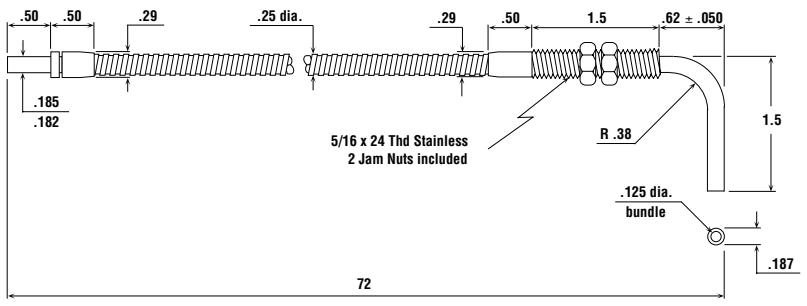
IR2.53SM2.5	36	0.156	SS	

Model IR2.53SM2.5 is used in applications where the required beam size is greater than 1.5" long. This model incorporates a different housing and cable exit than the standard IR2.53S. The 0.156" diameter fiber bundle on the photoelectric sensor end is the largest possible for efficient coupling of the light from the LED source into the fiber optic bundle. A typical application is counting small parts falling through the fiber window using sensor model OSBFAC. Also available is model IR2.53SM3. It has a fiber window 3.00 x .006".

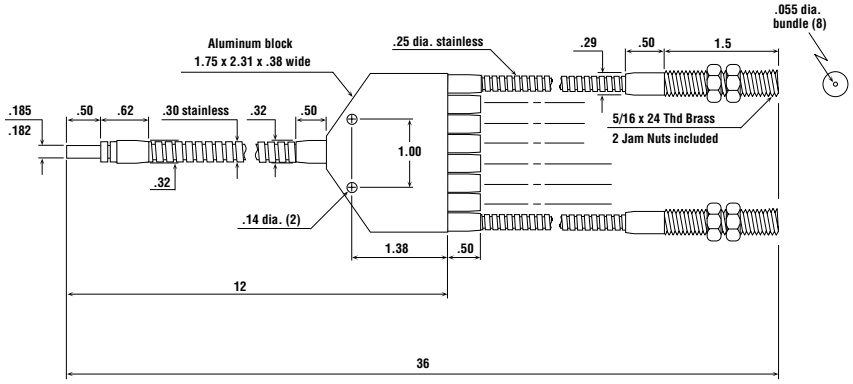
IR2.53SMRAMP	36	0.156	SS	

This customer-designed fiber is a modification of standard model IR2.53S. The cable exit and the mounting hole location are changed. This is one of many modifications possible to the large rectangular fiber optic assemblies.

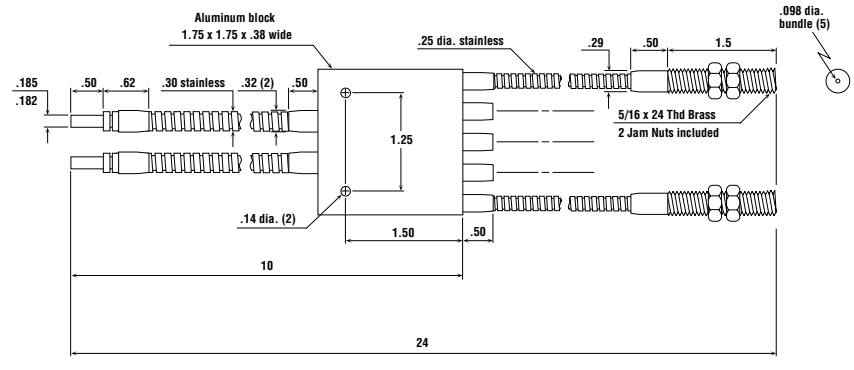
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
ITA26SM900	72	0.125	SS	

This assembly is a high temperature modification of standard fiber ITA23S. The length of the fiber is increased to 6' to allow the photoelectric control to reside outside of the high temperature environment. The end tip is constructed without the use of epoxy, allowing the fiber to operate in 900°F (+480°C) heat. Stainless steel is substituted for brass on the threaded end tip. This cable can be built in any length up to 60'.

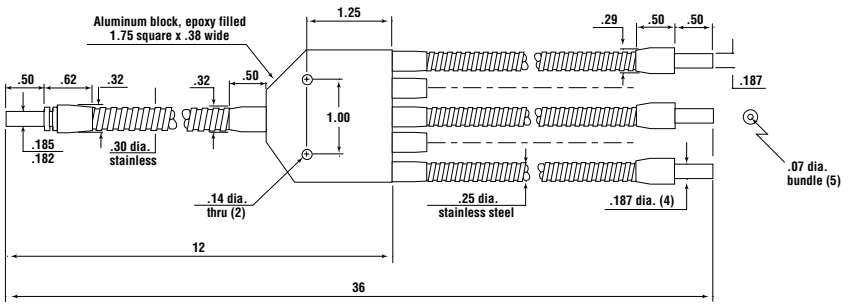
OF2.53SMTT	36	0.055 (8)	SS	

This Octa-Ferruled fiber Modified with Threaded Tips is used in pairs to set up an eight input “AND” gate, where all eight fiber beams must be broken to obtain an output (when the photoelectric sensor is used in the "dark operate" mode). This fiber is similar to model HF2.53SMTT, except it has eight ends instead of six. The maximum fiber bundle diameter (0.156") is used on the photoelectric sensor end, which creates 0.055" diameter bundles at all eight scanning ends.

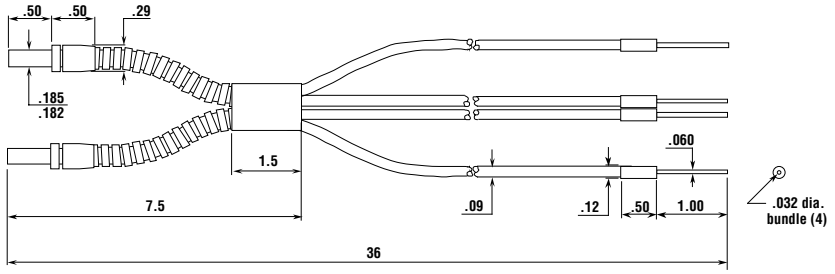
PBF2.52SMTT	24	0.098 (5)	SS	

This model is a Penta-Bifurcated Ferruled assembly that is Modified with Threaded Tip. It is used to set up a five input “OR” gate where if any one of the five sensing ends has light returned to it, an output occurs (when the photoelectric sensor is used in the "light operate" mode). The overall length of this assembly can be modified to suit your application. The ferruled ends which are used at the photoelectric sensor have the maximum allowable bundle size: 0.156" diameter. If more than five sensing ends are desired, the 0.098" diameter fiber bundles will be reduced in diameter.

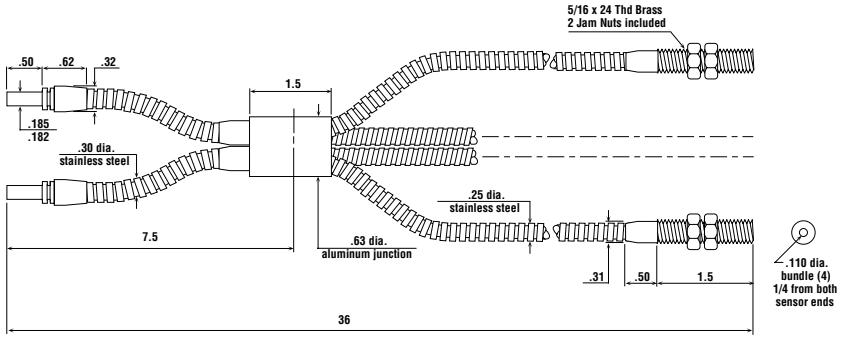
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
PF2.53S	36	0.070 (5)	SS	

This five-ferruled fiber is used in pairs to create 5 opposed beams using one photoelectric sensor. If the sensor is used in the light operate mode, a “light-or” logic function results. If “A” or “B” or “C”, etc. senses light, the output is energized. To determine the sensing range of the fiber, use the excess gain curve for model IT13S, located with the photoelectric sensor used for the application. The fiber optic cable uses the largest possible fiber optic bundle at the sensor end: 0.156" diameter.

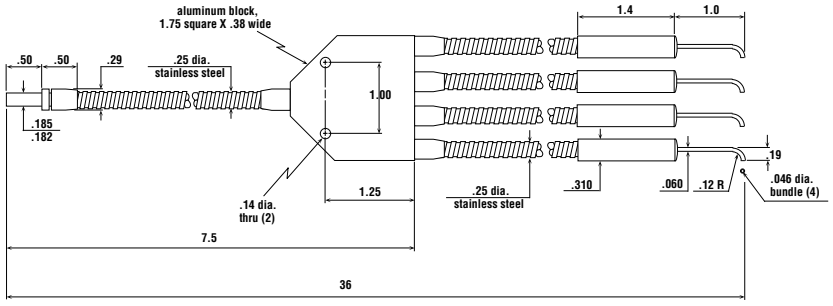
QBM.53P	36	0.032 (4)	SS/PVC	

This Quad-Bifurcated Miniature fiberoptic assembly with PVC sheathing allows a sensor to inspect four positions at one time. It was designed to detect when a hole is not centered in a metal washer. The four sensing ends are positioned 90° apart around the inside diameter of the washer. As the washer falls, guided through the inspection area, an interrogate (“gate”) signal tells the photoelectric sensor when to “look”. If the hole is off-center, one or more of the sensing ends will sense light reflected from the washer. The PVC sheathing on the sensing end legs of this assembly does not have a monocoil reinforcing wire.

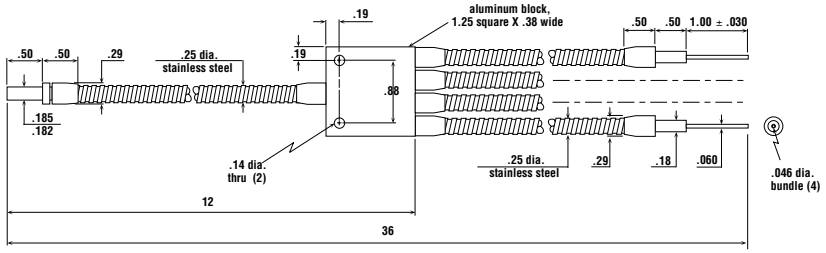
QBT23S	36	0.110 (4)	SS	

This fiber is similar to model DBT23S except it has four sensing ends. It is used in the diffuse sensing mode to set up a “light-OR” logic scheme. Both of the ferruled sensor ends contain the maximum bundle (0.156" diameter), and each sensing end has a fiber bundle diameter of 0.110". The fiber strands are fully randomized from each ferrule, so that each sensing end contains 1/4 of the bundle from each ferrule. An aluminum tube is used instead of a flat block at the bifurcation junction.

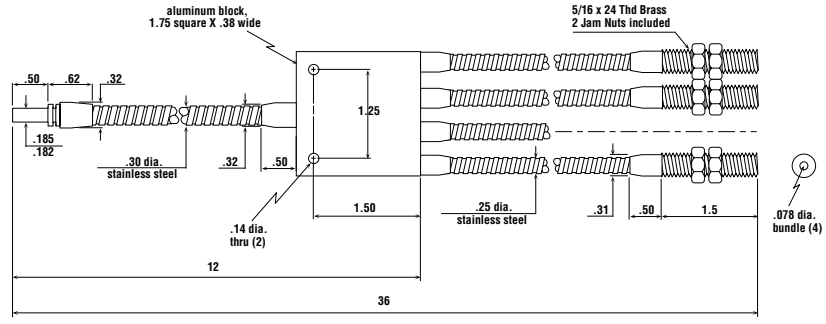
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
QF1.53SMAM	36	0.046	SS	

This fiber is an example of using multiple opposed miniature beams with one photoelectric sensor. Each sensing end has the same end tip as model IAM.752S for easy mounting via the "bullet" and the FMB-1 mounting bracket. This model is used in pairs, typically with a high powered infrared sensor. A pair of opposed 0.046" diameter fibers have 1/4 of the excess gain of a pair of 0.06" diameter fibers (e.g. IT13S); this corresponds to a range reduction of 50%.

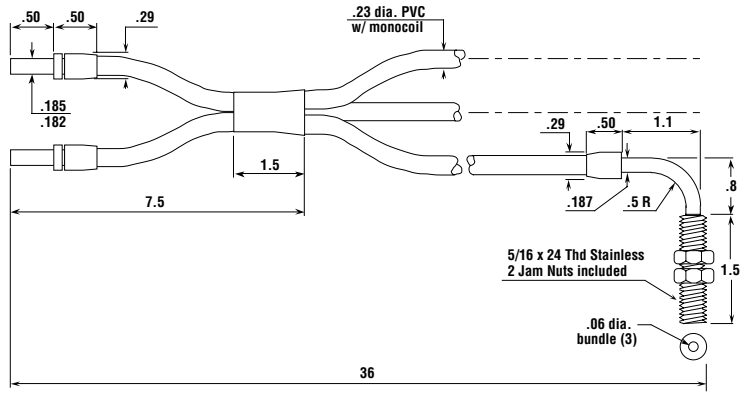
Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
QF1.53SMM	36	0.046 (4)	SS	

This assembly is similar to model QF1.53SMAM, shown on the previous page. The sensing end tips on this model have a one" long straight probe, without a right angle. The miniature end tips are not bendable. A typical application for this style of fiber is to determine if all parts are in place. When using a sensor in the dark-operate mode, an output will occur only when all four beams are blocked ("dark-AND" logic).

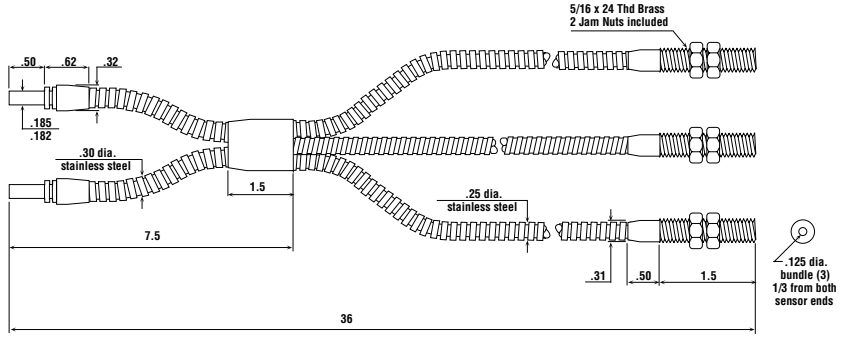
Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
QF2.53SMTT	36	0.078 (4)	SS	

The QF2.53SMTT is a four-channel version of model HF2.53SMTT. It has slightly larger fiber bundles on the sensing ends, allowing more excess gain. It was designed for use on a rotary index table to insure that all four parts were in place before the table could advance. Using two fibers and one sensor set for dark operate, a programmable controller "looks" for a signal from the sensor when the parts should be in place. If the controller does not receive a signal, the controller stops the machine and sounds an alarm.

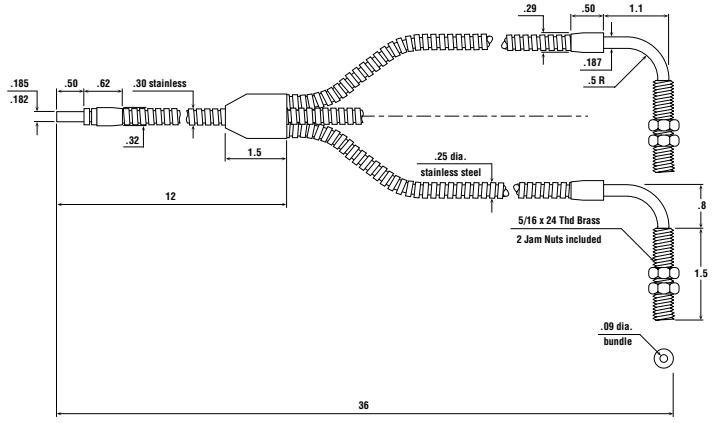
Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
TBAT13PMSS	36	0.060 (3)	SS	

This fiber is a Triple-Bifurcated Angle Threaded assembly with PVC sheathing and Modified Stainless Steel threads. It is designed for a machine requiring a three input “dark-AND” sensor. The machine punches out parts from a large sheet of plastic. The sensing ends are located just below the parts, in the die. At the end of a punch stroke, an interrogate (“gate”) signal occurs to check the output from the photoelectric sensor. If any one of the three sensing ends sense a part (light operate) during the gate signal, the machine is shut down to avoid damage to the die.

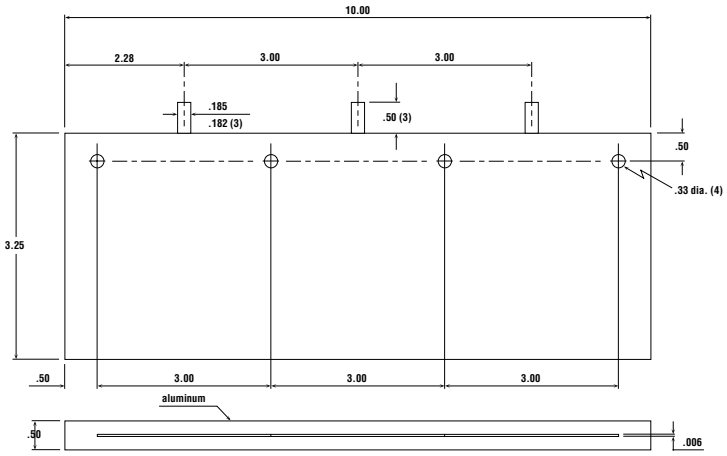
TBT23S	36	0.125 (3)	SS	

This Trifurcated-Bifurcated Threaded assembly is a three-legged version of the popular standard model BT23S. When determining the range of this fiber, use the excess gain curve for fiber model BT23S across from the photoelectric sensor you have chosen.

TF2.53SMAT	36	0.090 (3)	SS	

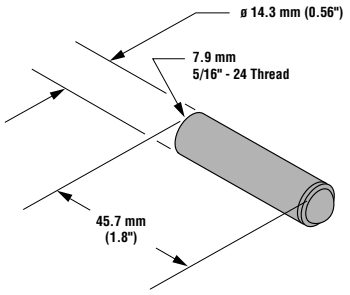
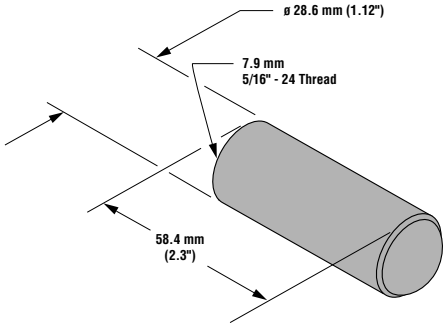
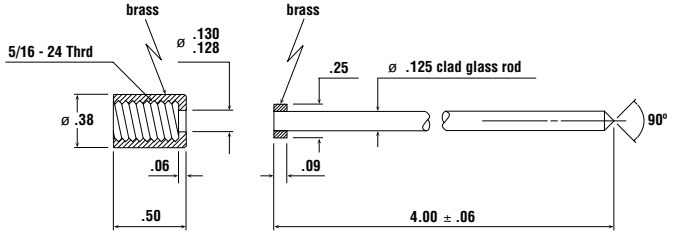
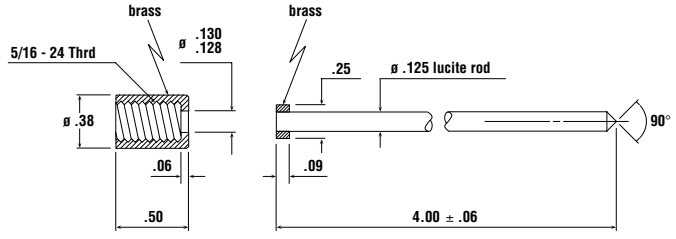
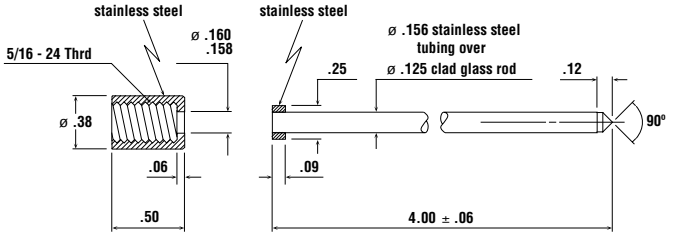
This assembly was designed as a Trifurcated-Ferruled version of model IAT23S. However, the bundle size on the sensing end tips is 0.09" in diameter. Opposed sensing range can be increased with the use of L9 or L16F lenses. The lenses should be used on all three ends of the two opposed fibers to achieve the maximum sensing range.

Custom Glass Fibers

Model	Length (in)	Bundle Diameter (in)	Sheath/ Construc-tion	Dimensions (in)
TIR2.5M9X.006	10	(3) 0.006 x 3.00	SS and Aluminum	

This Triple-Individual Rectangular assembly is used in the opposed mode (2 required) to cover an area nine inches wide. It may be used with high- powered sensor pair SM51EB6 and SM51RB6 equipped with FOF-500 fittings, for detecting small holes in opaque webs.

Glass Fiber Optic Accessories

Model	Description	
L10	• Glass lens with anodized red aluminum housing • Used with bifurcated threaded fibers primarily for register mark sensing • The L10 lens focuses the light to a point as small as 1/32" when used with a 0.06 in diameter fiber bundle • Should not be used with high-powered infrared sensors • Maximum temperature: 600°F (315°C) • Focal distance is 5 mm (±1 mm) (0.20" ±0.04")	
L16F **L16FAL** **L16FSS**	Delrin® housing; 220°F (105°C) max temp Anodized aluminum housing; 600°F (315°C) max temp Stainless steel housing; 900°F (480°C) max temp Used for long range opposed or retroreflective sensing	
TGR	• Tubular glass rod • Used for liquid level sensing • When used with bifurcated threaded fiber, the light is reflected back to the sensor when the probe is not in the liquid • Used where chemical and acid resistance is required	
TLR	• Tubular lucite rod • Used for liquid level sensing • It is less fragile than glass version (TGR) and is used in general purpose applications • Probe length modifications of both models are available by special order	
TGRMSSMCG-4	• Tubular glass rod, modified stainless steel, covered glass • Liquid level probe same as TGR, except inside stainless steel tubing and more durable than TGR • Epoxy used to bond the tubing to the rod is not acid or solvent resistant	

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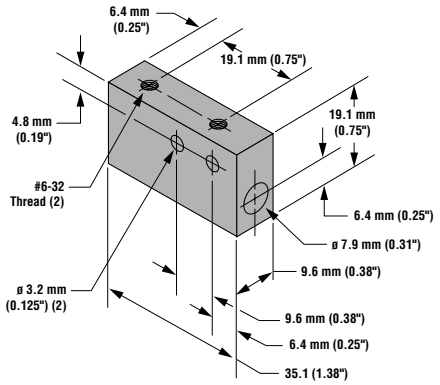
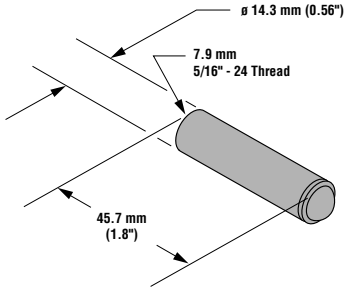
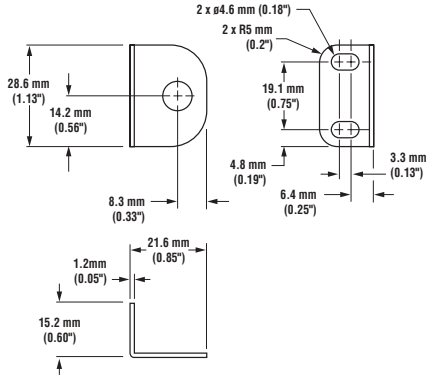
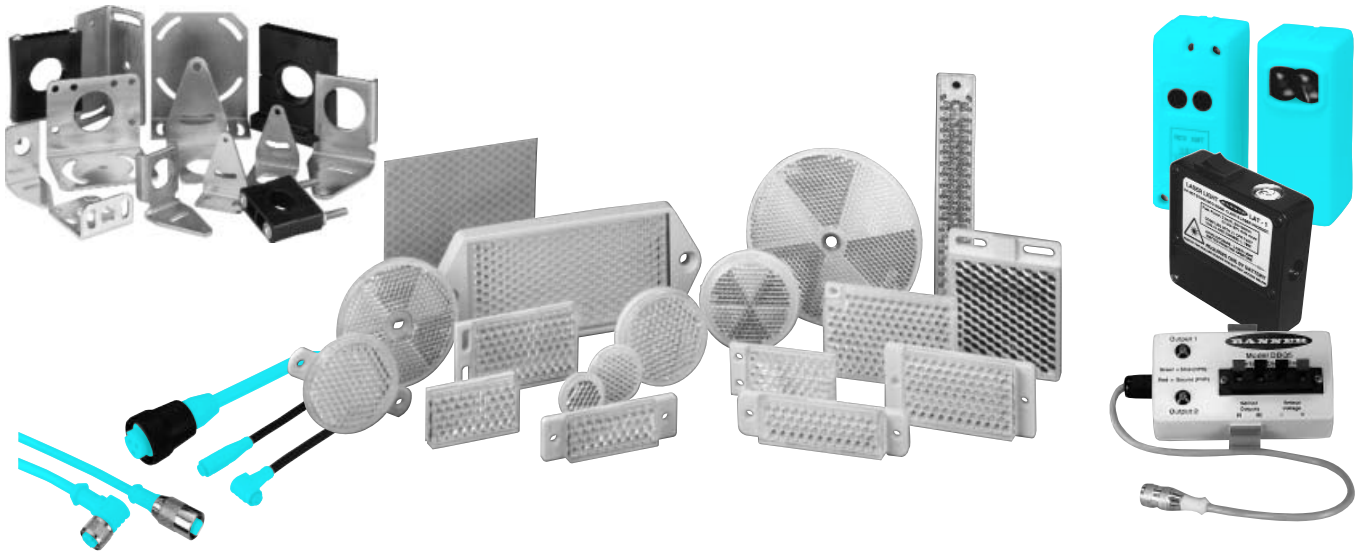
Glass Fiber Optics Accessories

Model	Description	
FMB-1	• Fiber mounting bracket • Can be used with many probe style fibers • The bracket eliminates the need to mount the fiber using its smaller and more fragile bendable probe • The fiber is held in place by two setscrews (wrench included)	
L9	• Glass lens with anodized blue aluminum housing • Used to extend the range of opposed mode fiber optics systems • Used also with a bifurcated fiber (BT13S) for short-range retroreflective sensing • The smaller fiber bundle (0.06" diameter) is desirable for retroreflective use • Maximum temperature: 600°F (315°C)	

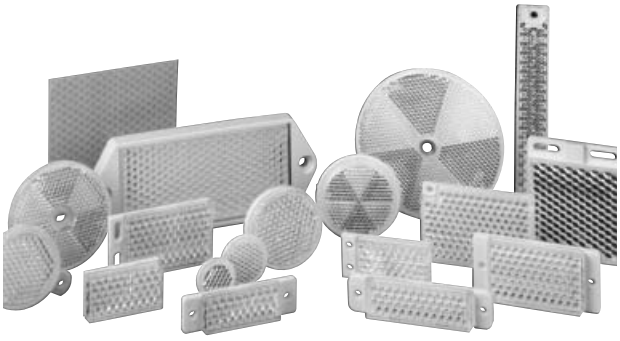
Mounting Brackets

Model	Description	Dimensions
SMBF 	• Right angle bracket for glass fiber optics with $^{5}/_{16}$" - 24 threaded tip • 18-gauge stainless steel	



Accessories

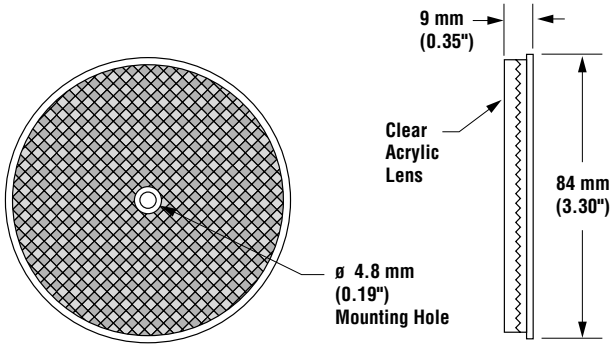
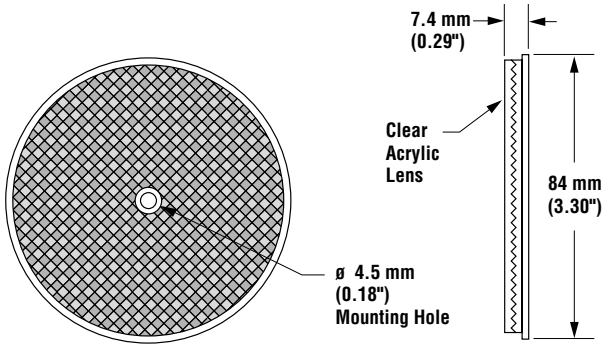
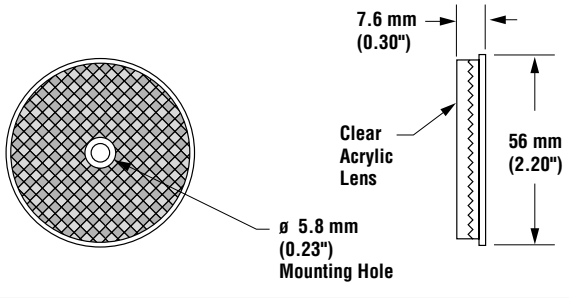
Retroreflectors



- High-quality acrylic targets, high-temperature targets, and adhesive-backed retro tapes
- Comprehensive selection of sizes, shapes and mounting options
- Banner also offers several "micro-prism" reflectors, for use with laser retroreflective sensors and Banner VS3 models.

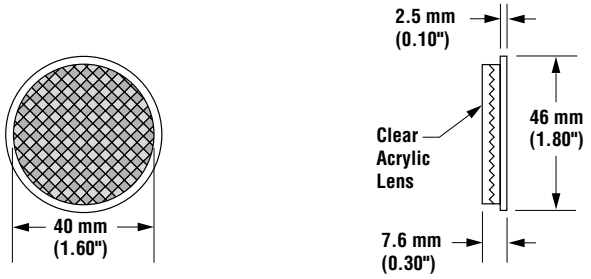
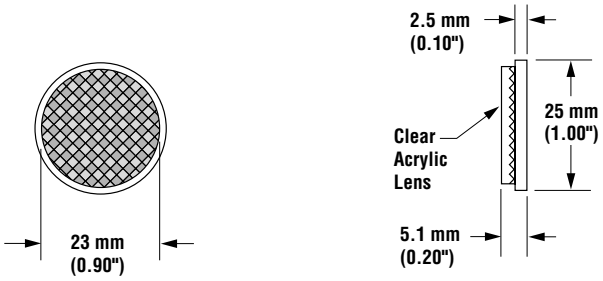
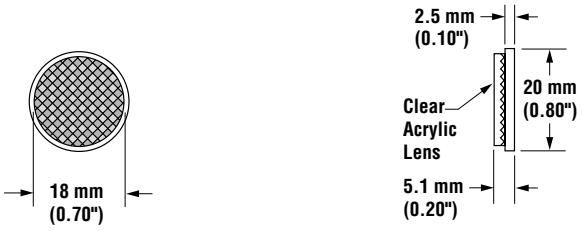
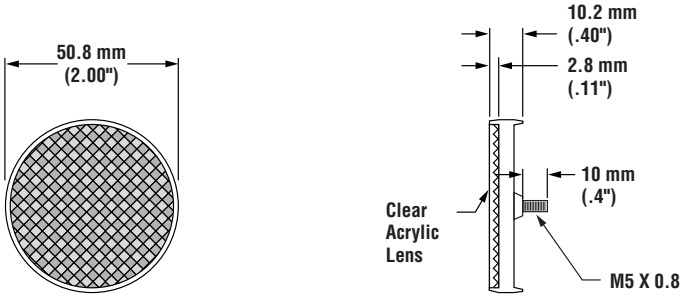
NOTE: Sensing range and signal strength at any given sensor-to-target distance will vary due to target reflectivity and target area. A "Reflectivity Factor" is included for each target model to help predict sensor performance, relative to the excess gain curve plotted for target model BRT-3. Consider, also, target area when predicting performance. Changing to a high reflectivity reflector (like BRT-92x92C) may also extend sensor range and/or reduce the need for frequent reflector maintenance.

Retroreflective Targets

Model	Reflectivity Factor	Maximum Temperature	Dimensions
BRT-3*	1.0	65°C (150°F)	
BRT-84*	1.4	65°C (150°F)	
BRT-2A	1.0	65°C (150°F)	

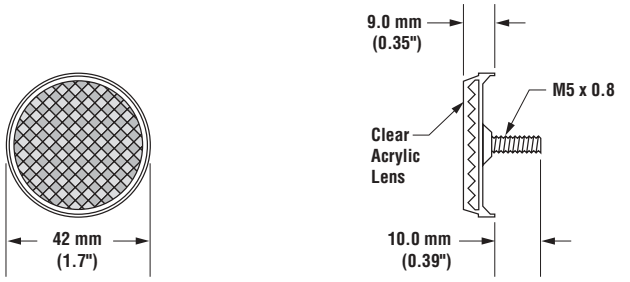
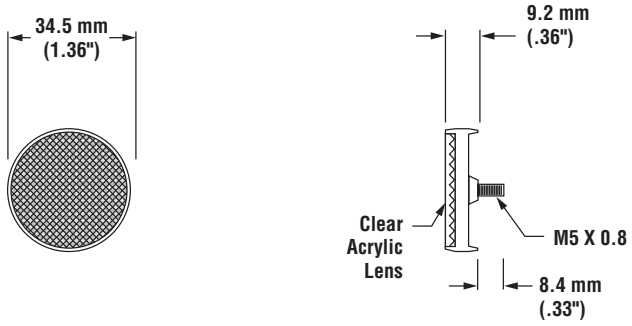
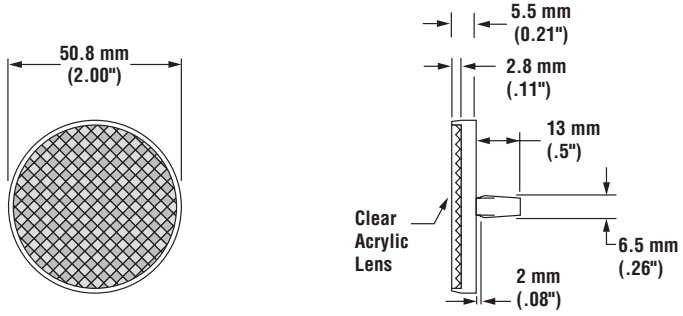
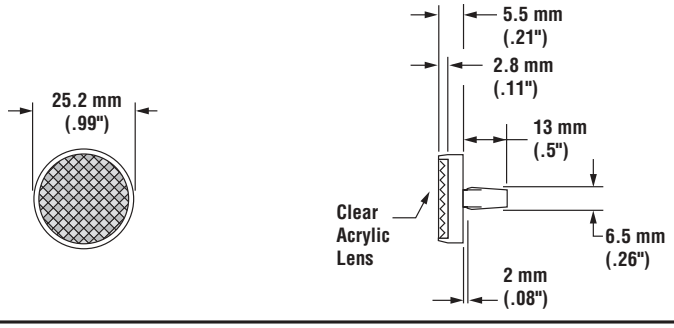
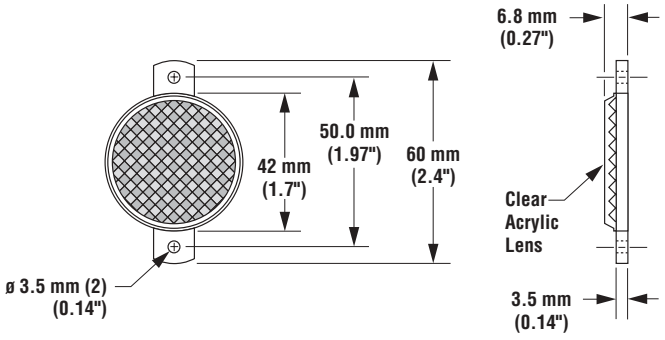
* Optional brackets are available. See Brackets on pages 740 and 741.

Retroreflective Targets

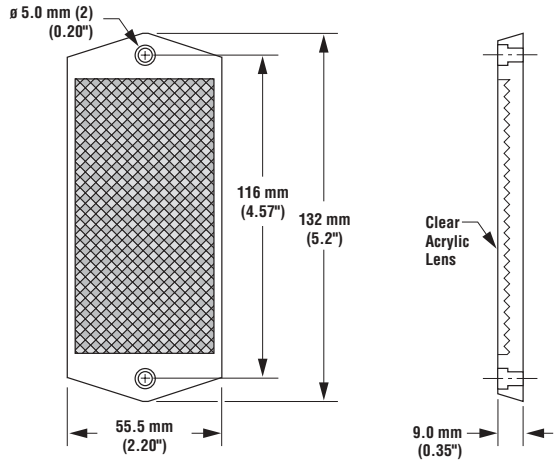
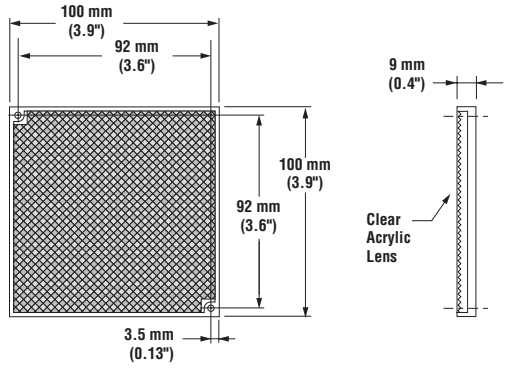
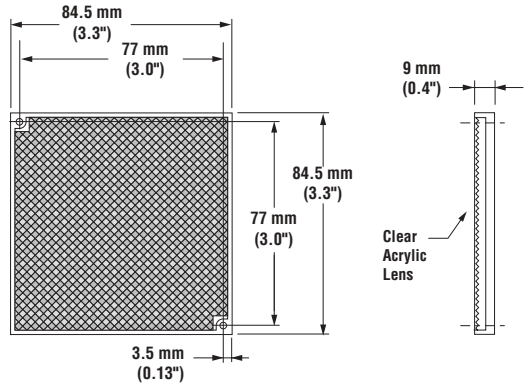
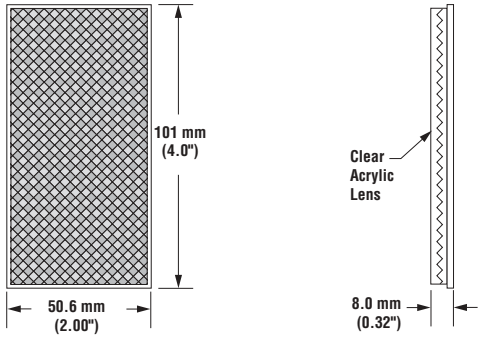
Model	Reflectivity Factor	Maximum Temperature	Dimensions
BRT-50	1.0	65°C (150°F)	
BRT-1.5	1.0	65°C (150°F)	
BRT-1	1.0	65°C (150°F)	
BRT-.6	1.0	65°C (150°F)	
BRT-50D*	1.0	65°C (150°F)	

* Optional brackets are available. See Brackets on pages 740 and 741.

Retroreflective Targets

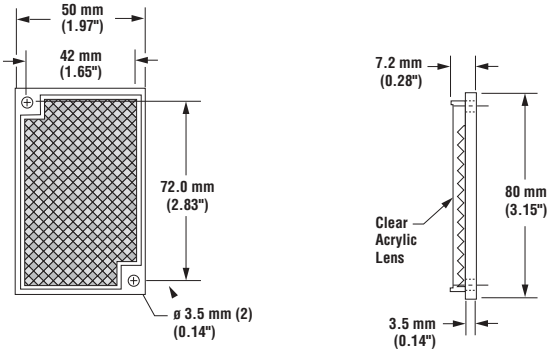
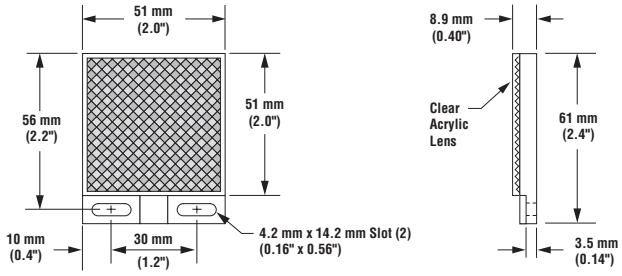
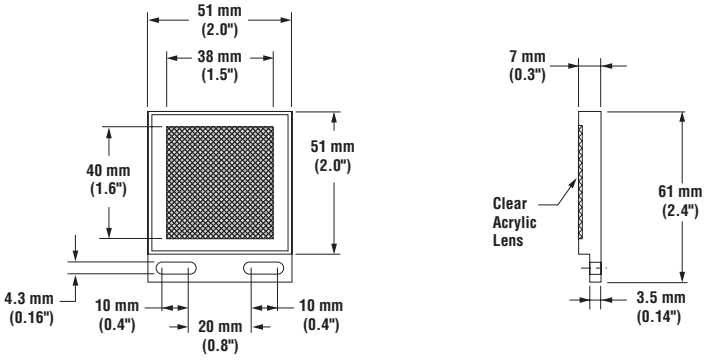
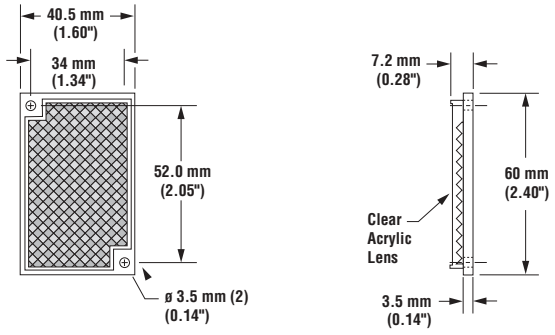
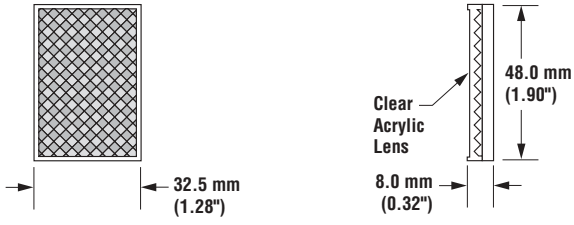
Model	Reflectivity Factor	Maximum Temperature	Dimensions
BRT-42D	1.0	50°C (120°F)	
BRT-35DM	1.2	50°C (120°F)	
NOTE: This target has micro-prism geometry			
BRT-50R*	1.0	50°C (120°F)	
BRT-25R	1.0	50°C (120°F)	
BRT-42A	1.0	50°C (120°F)	

Retroreflective Targets

Model	Reflectivity Factor	Maximum Temperature	Dimensions
BRT-100X55A	1.5	50°C (120°F)	
BRT-92X92C*	3.0	50°C (120°F)	
BRT-77X77C*	2.0	50°C (120°F)	
BRT-100X50	1.5	50°C (120°F)	

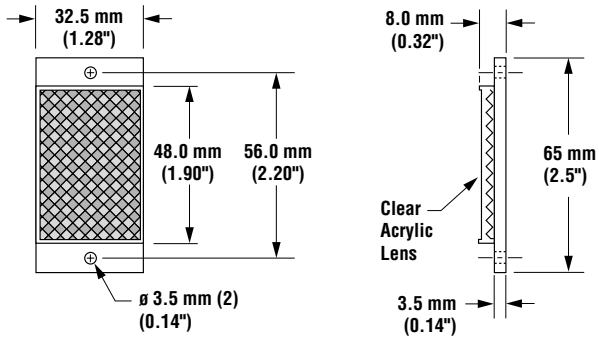
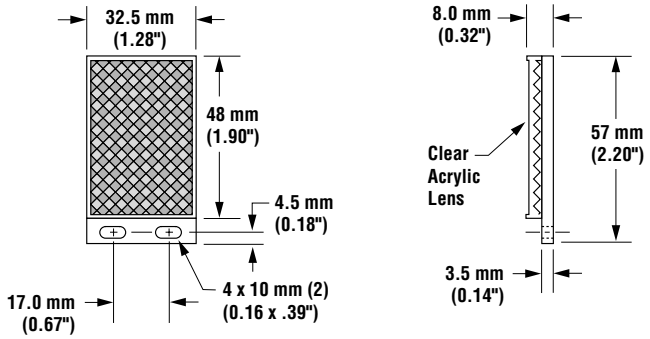
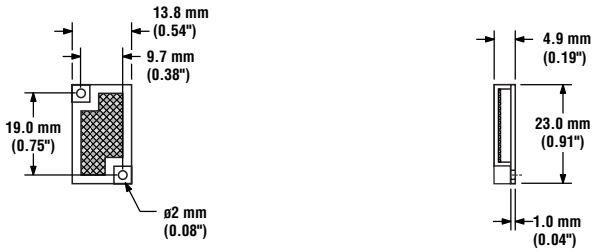
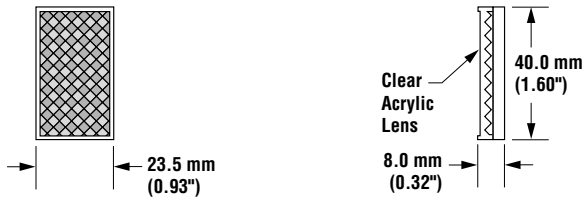
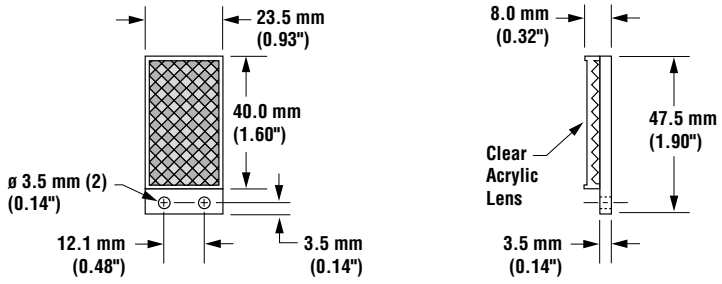
* Optional brackets are available. See Brackets on pages 740 and 741.

Retroreflective Targets

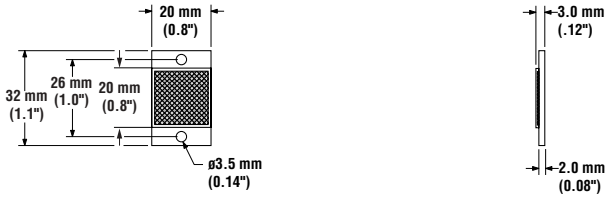
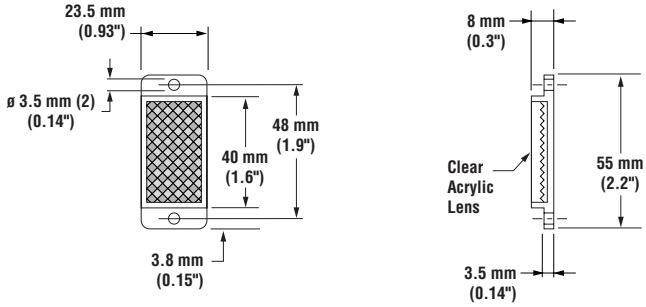
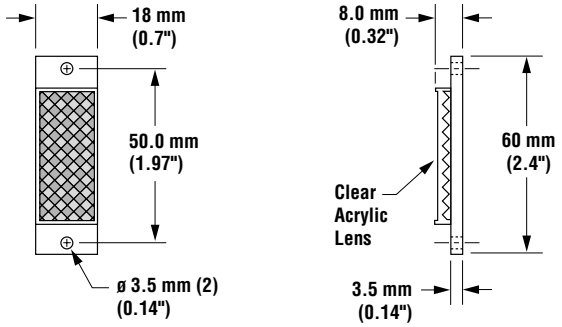
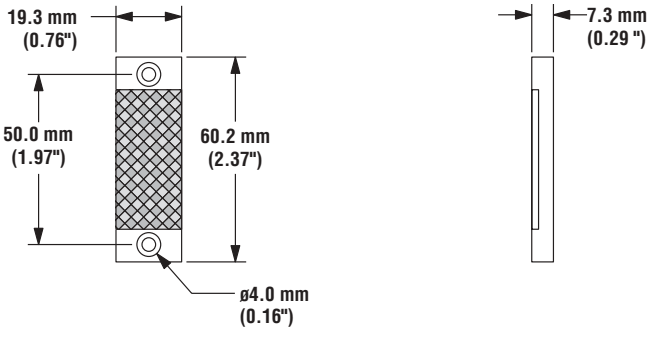
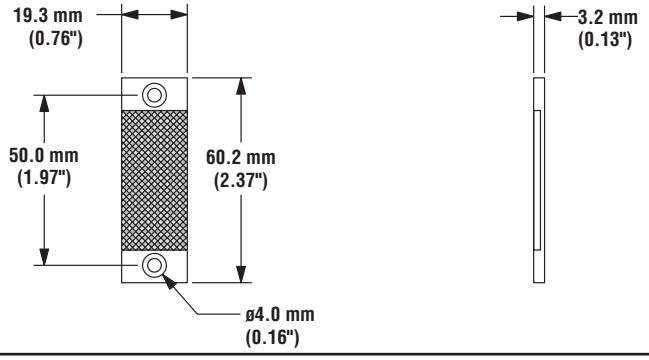
Model	Reflectivity Factor	Maximum Temperature	Dimensions
BRT-80X50C	1.4	65°C (150°F)	
BRT-2X2*	1.0	50°C (120°F)	
BRT-36X40BM	1.2	50°C (120°F)	
			NOTE: This target has micro-prism geometry
BRT-60X40C*	1.4	50°C (120°F)	
BRT-48X32	1.0	50°C (120°F)	

* Optional brackets are available. See Brackets on pages 740 and 741.

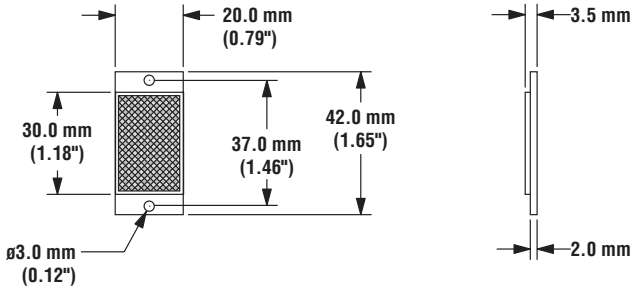
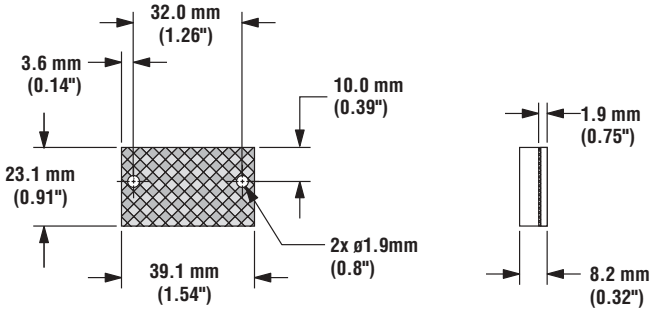
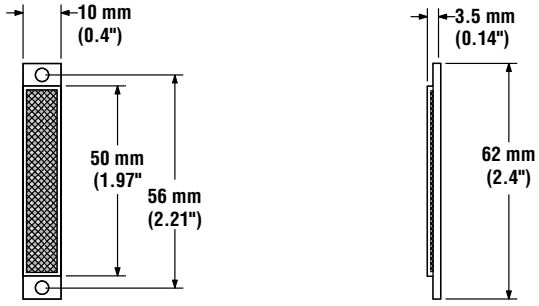
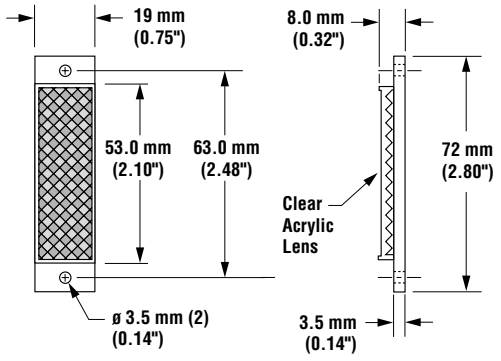
Retroreflective Targets

Model	Reflectivity Factor	Maximum Temperature	Dimensions
BRT-48X32A	1.0	50°C (120°F)	
BRT-48X32B	1.0	50°C (120°F)	
BRT-23X14CM NOTE: This target has micro-prism geometry	1.2	65°C (150°F)	
BRT-40X23	1.4	50°C (120°F)	
BRT-40X23B	1.4	50°C (120°F)	

Retroreflective Targets

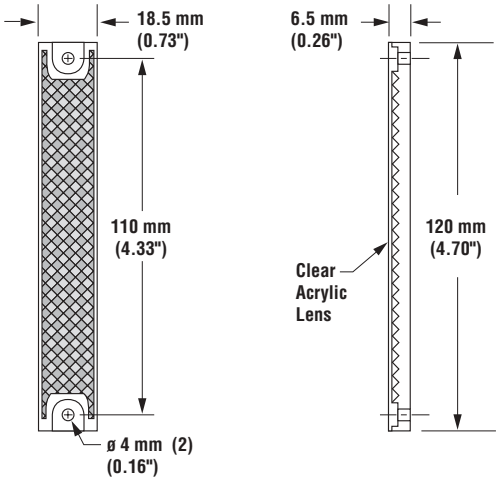
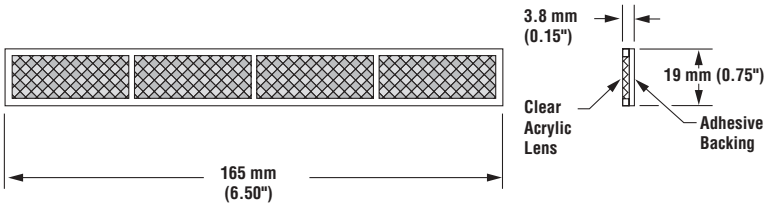
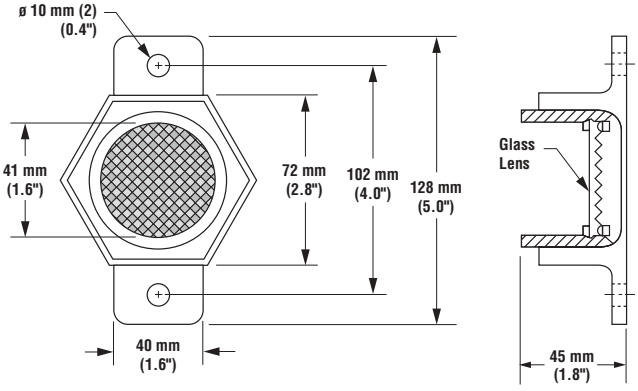
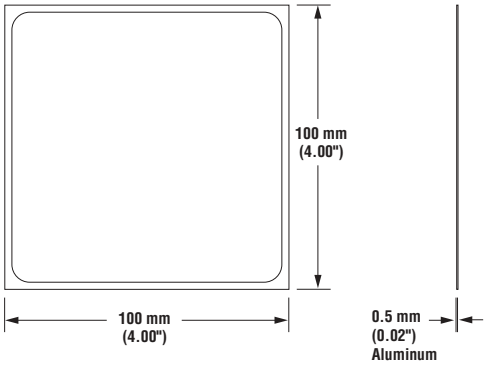
Model	Reflectivity Factor	Maximum Temperature	Dimensions
BRT-32X20AM	1.2	65°C (150°F)	
NOTE: This target has micro-prism geometry			
BRT-35X20A	1.4	50°C (120°F)	
BRT-40X18A	1.0	50°C (120°F)	
BRT-40X19A	1.3	50°C (120°F)	
BRT-40X19AM	1.2	50°C (120°F)	
NOTE: This target has micro-prism geometry			

Retroreflective Targets

Model	Reflectivity Factor	Maximum Temperature	Dimensions
BRT-40X20AM NOTE: This target has micro-prism geometry	1.2	50°C (120°F)	
BRT-40X23A	1.4	50°C (120°F)	
BRT-62X10AM NOTE: This target has micro-prism geometry	1.2	65°C (150°F)	
BRT-53X19A	1.4	50°C (120°F)	

†These targets are not recommended for polarized retroreflective sensors

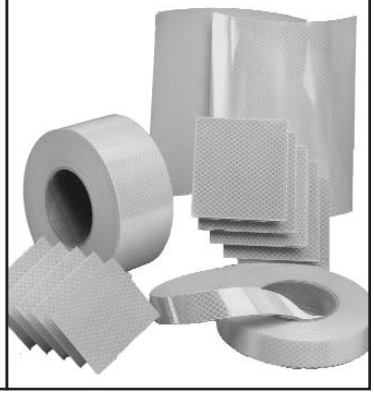
Retroreflective Targets

Model	Reflectivity Factor	Maximum Temperature	Dimensions
BRT-100X18A	1.4	50°C (120°F)	
BRT-L	0.8	65°C (150°F)	
BRT-41AHT	1.0	200°C (390°F)	
BRT-4HT†	0.15	480°C (900°F)	

† These targets are not recommended for polarized retroreflective sensors.

Retroreflective Tape

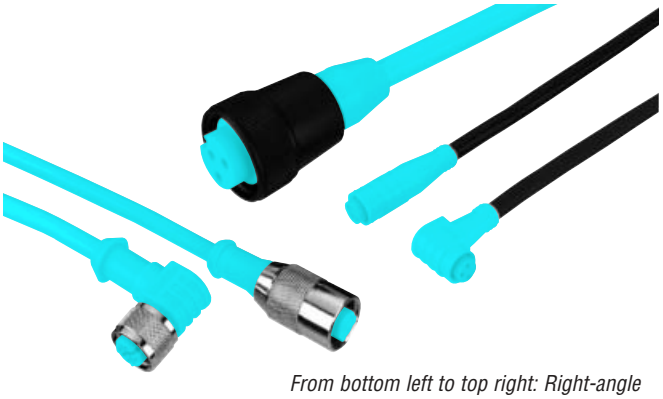
Note: for maximum adhesion of all tape products, surfaces must be clean.

Model	Reflectivity Factor	Maximum Temperature	Size	Unit	
BRT-THG-3X3-10	0.7	60°C (140°F)	75 x 75 mm (3 x 3")	Package of 10	
BRT-THG-4X4-5	0.7	60°C (140°F)	100 x 100 mm (4 x 4")	Package of 5	
BRT-THG-8.5X11-2	0.7	60°C (140°F)	216 x 280 mm (8.5 x 11")	Package of 2	
BRT-THG-18X36	0.7	60°C (140°F)	457 x 914 mm (18 x 36")	Single Sheet	
BRT-THG-1-100	0.7	60°C (140°F)	25 mm (1") wide	2.5 m (100") length	
BRT-THG-2-100	0.7	60°C (140°F)	50 mm (2") wide	2.5 m (100") length	
BRT-THG-3-100	0.7	60°C (140°F)	75 mm (3") wide	2.5 m (100") length	
BRT-T-100†	0.2	65°C (150°F)	25 mm (1") wide	2.5 m (100") length	
BRT-THT-100†	0.07	175°C (350°F)	25 mm (1") wide	2.5 m (100") length	
BRT-TVHG2X2*	0.8	60°C (140°F)	50 x 50 mm (2 x 2")	Package of 4	

† These targets are not recommended for polarized retroreflective sensors.

* These are sealed micro-prism style pieces and may not be cut.
Suitable for use with Laser sensors, VS3 sensors and SME312LPC model sensors.
Not suggested for close range (less than 4") except with VS3 sensors.

Cables and Connectors



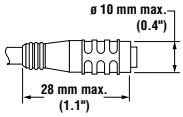
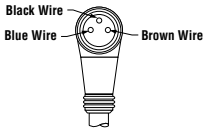
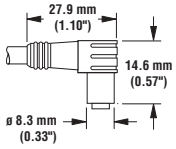
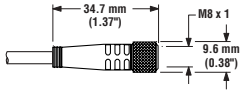
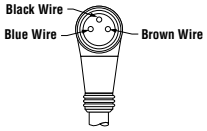
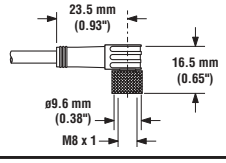
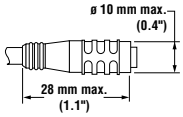
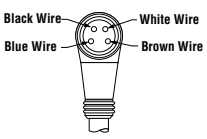
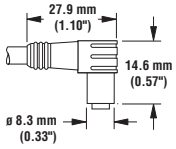
From bottom left to top right: Right-angle Micro-, Straight Micro-, Right-angle Pico-, Straight Pico- and Mini-style cables

Quick-disconnect (QD) cables allow sensors to be replaced or moved quickly, minimizing down-time

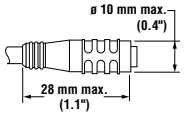
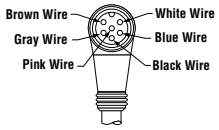
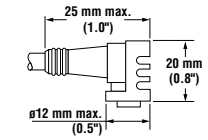
- Pico-, euro-, and mini-styles are available for dc-powered sensors
- Micro- and mini-styles are available for ac-powered sensors
- Choose straight or right-angle connectors
- Mini-style receptacles are available for creating quick-disconnect MULTI-BEAM, MAXI-BEAM and Q85 Series sensors
- Pico- and euro-style field-wireable connectors

Pico-Style Quick-Disconnect Cables

Cable: PUR jacket, polyurethane connector body, POM snap-lock coupling
Conductors: 26 or 24 AWG high-flex stranded, gold-plated contacts
Temperature: -40 to +90°C (-40 to +194°F)
Voltage Rating: 30V ac/36V dc

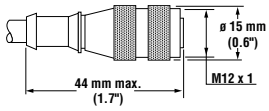
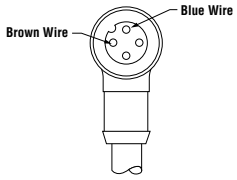
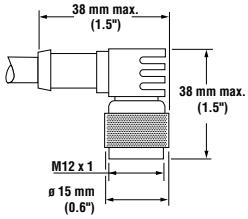
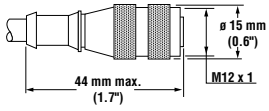
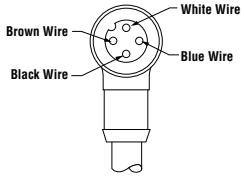
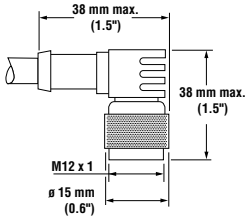
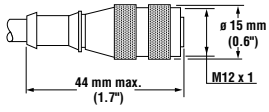
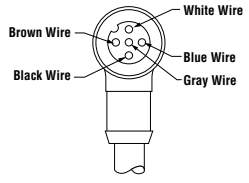
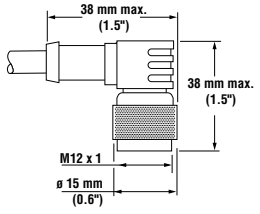
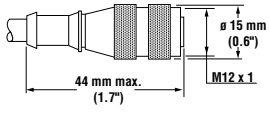
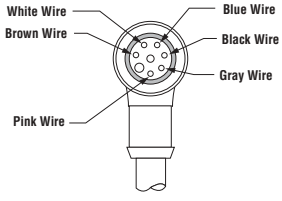
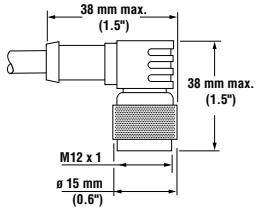
Style	Model	Length	Connection Type	Used with:	Dimensions	Pin-out
3-Pin Straight	**PKG3-2**	2 m (6.5')	Snap-on	• M12 Laser emitters • Q08 Diffuse Mode sensors • Q10 series • Q14 series		
3-Pin Right-angle	**PKW3-2**	2 m (6.5')	Snap-on			
3-Pin Straight	**PKG3M-2** **PKG3M-9**	2 m (6.5') 9 m (30')	Threaded	• VS1 series • VS2 series • VS3 series		
3-Pin Right-angle	**PKW3M-2** **PKW3M-9**	2 m (6.5') 9 m (30')	Threaded			
4-Pin Straight	**PKG4-2**	2 m (6.5')	Snap-on	• MINI-BEAM 2 • Q23 series • D11 series • D12 series • EZ-BEAM S12 series • PICO-AMP		
4-Pin Right-angle	**PKW4-2**	2 m (6.5')	Snap-on			

Pico-Style Quick-Disconnect Cables (continued)

Style	Model	Length	Connection Type	Used with:	Dimensions	Pin-out
6-Pin Straight	**PKG6Z-2** **PKG6Z-9**	2 m (6.5') 9 m (30')	Snap-on	• D10 Series sensors		
6-Pin Right-angle	**PKW6Z-2** **PKW6Z-9**	2 m (6.5') 9 m (30')	Snap-on			

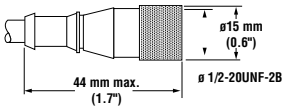
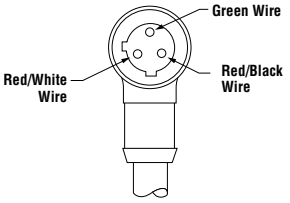
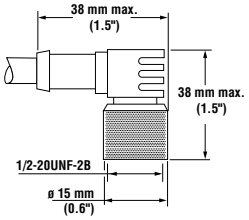
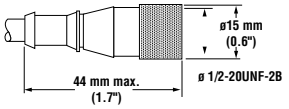
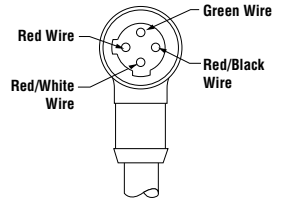
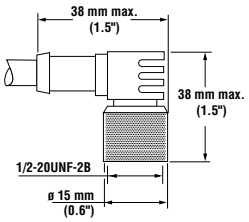
Euro-Style Quick-Disconnect Cables

Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 22 or 20 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40 to +90°C (-40 to +194°F)
Voltage Rating: 250V ac/300V dc

Style	Model	Length	Used with:	Dimensions	Pin-out
4-Pin Straight	**MQD9-406** **MQD9-415**	2 m (6.5') 5 m (15')	• MINI-BEAM and Q45 series NAMUR sensors		
4-Pin Right-angle	**MQD9-406RA** **MQD9-415RA**	2 m (6.5') 5 m (15')			
4-Pin Straight	**MQDC-406** **MQDC-415** **MQDC-430**	2 m (6.5') 5 m (15') 9 m (30')	• Standard OMNI-BEAM (QDH suffix) • Q45 dc sensors (Q5 suffix) • MINI-BEAM dc SM312 series • EZ-BEAM dc (Q suffix except S12) • SP12 series • QM42 series • PVA sensors		
4-Pin Right-angle	**MQDC-406RA** **MQDC-415RA** **MQDC-430RA**	2 m (6.5') 5 m (15') 9 m (30')			
5-Pin Straight	**MQDC1-506** **MQDC1-515** **MQDC1-530**	2 m (6.5') 5 m (15') 9 m (30')	• MINI-BEAM *Expert* • PicoDot • Q45 Laser Retro • R55 • R55F • SL30, SL30E • SL10, SL10E • Q60		
5-Pin Right-angle	**MQDC1-506RA** **MQDC1-515RA** **MQDC1-530RA**	2 m (6.5') 5 m (15') 9 m (30')			
6-Pin Straight	**MQDC-606** **MQDC-615** **MQDC-630**	2 m (6.5') 5 m (15') 9 m (30')	• R55 Expert series		
6-Pin Right-angle	**MQDC-606RA** **MQDC-615RA** **MQDC-630RA**	2 m (6.5') 5 m (15') 9 m (30')			

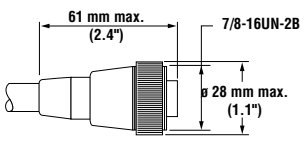
Micro-Style Quick-Disconnect Cables

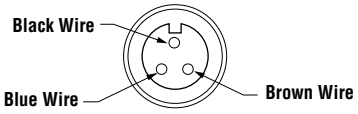
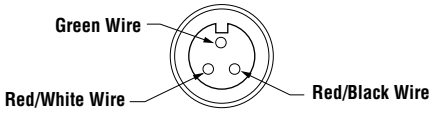
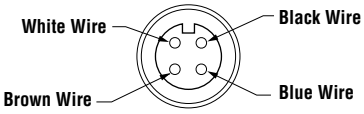
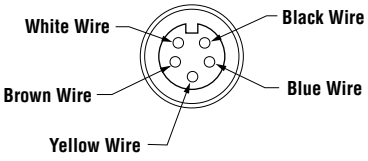
Cable: PVC jacket, polyurethane connector body, chrome-plated brass coupling nut
Conductors: 22 or 20 AWG high-flex stranded, PVC insulation, gold-plated contacts
Temperature: -40 to +80°C (-40 to +176°F)
Voltage Rating: 250V ac/300V dc (3-pin), 125V ac/150V dc (4-pin)

Style	Model	Length	Used with:	Dimensions	Pin-out
3-Pin Straight	**MQDC-306** **MQDC-315** **MQDC-330**	2 m (6.5') 5 m (15') 9 m (30')	• MINI-BEAM ac SM2A312 series		
3-Pin Right-angle	**MQDC-306RA** **MQDC-315RA** **MQDC-330RA**	2 m (6.5') 5 m (15') 9 m (30')			
4-Pin Straight	**MQAC-406** **MQAC-415** **MQAC-430**	2 m (6.5') 5 m (15') 9 m (30')	• Q45 ac series (suffix Q1) • EZ-BEAM ac series (suffix Q1)		
4-Pin Right-angle	**MQAC-406RA** **MQAC-415RA** **MQAC-430RA**	2 m (6.5') 5 m (15') 9 m (30')			

Mini-Style Quick-Disconnect Cables

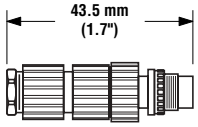
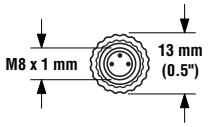
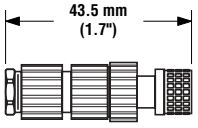
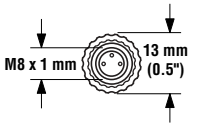
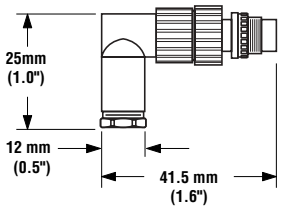
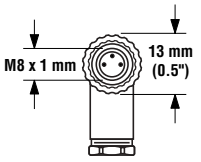
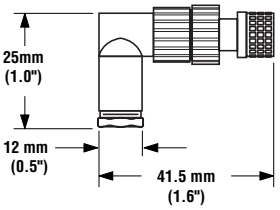
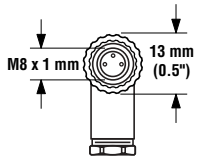
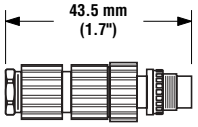
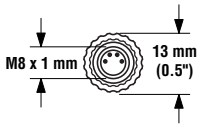
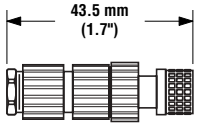
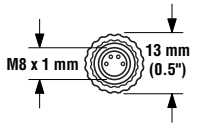
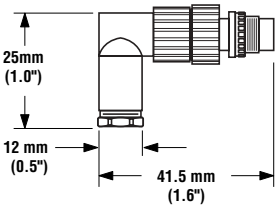
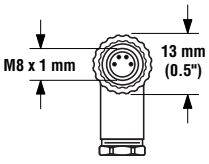
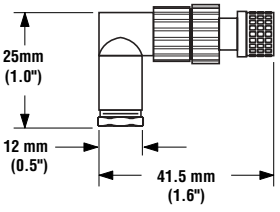
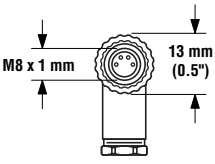
Cable: PVC jacket, polyurethane connector body, nylon coupling nut
Conductors: 18 AWG high-flex stranded, PVC insulation, gold plated contacts
Temperature: -40 to +80°C (-40 to +176°F)
Voltage Rating: 250V ac/300V dc



Style	Model	Length	Used with:	Pin-out
3-Pin Female Pin-out Straight	**MBCC-306** **MBCC-312** **MBCC-330**	2 m (6.5') 4 m (12') 9 m (30')	• Q45 3-wire ac (Q suffix) • VALU-BEAM 2-wire • VALU-BEAM emitters • VALU-BEAM 990 series	
3-Pin Female Pin-out Straight	**SM30CC-306** **SM30CC-312**	2 m (6.5') 4 m (12')	• SM30 2-wire ac	
4-Pin Female Pin-out Straight	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')	• Q45 dc (Q suffix) • OMNI-BEAM dc power blocks • VALU-BEAM 912 dc series • SM30 dc series • Optical Touch Button (OTB) w/solid-state output	
5-Pin Female Pin-out Straight	**MBCC-506** **MBCC-512** **MBCC-530**	2 m (6.5') 4 m (12') 9 m (30')	• Q45 Laser Retro • OMNI-BEAM ac power blocks • OMNI-BEAM dc with e/m relay • VALU-BEAM 915 series • OTB & LTB w/SPDT relay • Q45 series 5-wire ac • Q45X series	

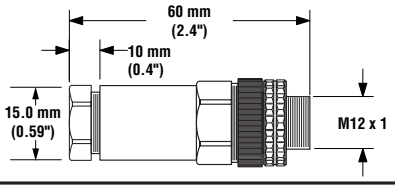
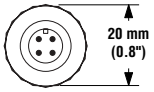
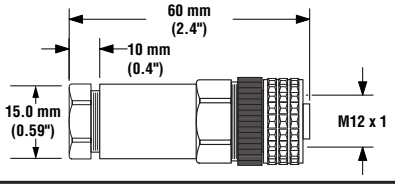
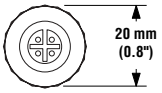
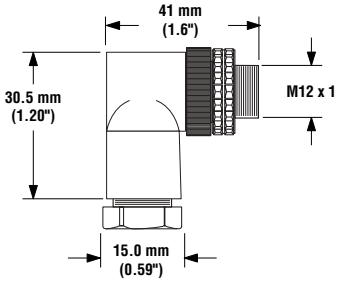
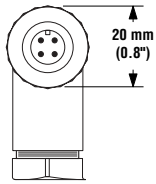
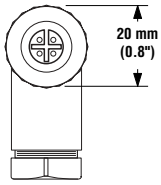
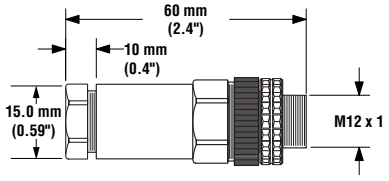
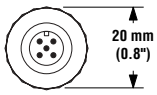
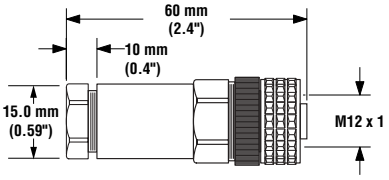
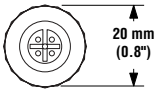
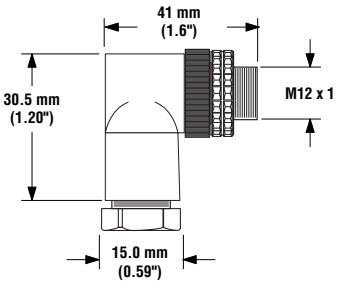
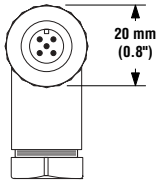
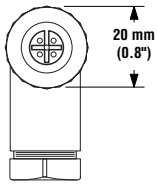
Pico-Style Field-Wireable Connectors

Contacts: Gold-plated; rated 60V ac/dc max., 4 A max.
Cable Diameter: 4.0 to 5.0 mm (0.16 to 0.20")
Temperature: -25 to +70°C (-13 to +156°F)
Environmental Rating: NEMA 6P, IP 67

Style	Model	Gender	Dimensions	Pin-out
3-Pin Straight	**FIC-M8M3**	Male		
	FIC-M8F3	Female		
3-Pin Right-angle	**FIC-M8M3A**	Male		
	FIC-M8F3A	Female		
4-Pin Straight	**FIC-M8M4**	Male		
	FIC-M8F4	Female		
4-Pin Right-angle	**FIC-M8M4A**	Male		
	FIC-M8F4A	Female		

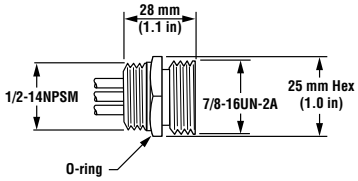
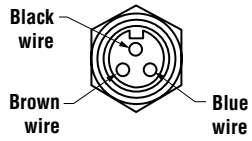
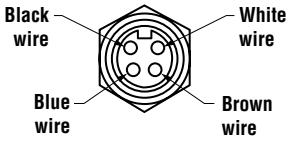
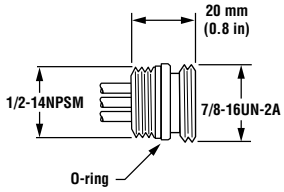
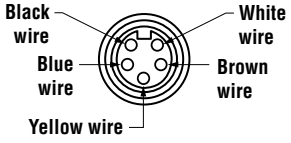
Euro-Style Field-Wireable Connectors

Contacts: Gold-plated; 4-pin models rated 250V ac/dc max., 4 A max.; 5-pin models rated 50V ac/dc max., 4A max.
Cable Diameter: 4.0 to 5.0 mm (0.16 to 0.20")
Temperature: -25 to +90°C (-13 to +194°F)
Environmental Rating: NEMA 6P, IP 67

Style	Model	Gender	Dimensions	Pin-out
4-Pin Straight	**FIC-M12M4**	Male		
	FIC-M12F4	Female		
4-Pin Right-angle	**FIC-M12M4A**	Male		
	FIC-M12F4A	Female		
5-Pin Straight	**FIC-M12M5**	Male		
	FIC-M12F5	Female		
5-Pin Right-angle	**FIC-M12M5A**	Male		
	FIC-M12F5A	Female		

Mini-Style Quick-Disconnect Receptacles

Housing: Nickel chrome-plated brass or zinc alloy
Conductors: 20 AWG (3- and 4-pin), or 24 AWG (5-pin), PVC insulation, gold plated pins
Temperature: -40 to +70°C (-40 to +158°F)
Voltage Rating: 600V ac (3-pin), 300V ac (5-pin)

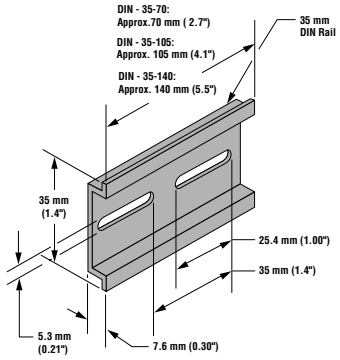
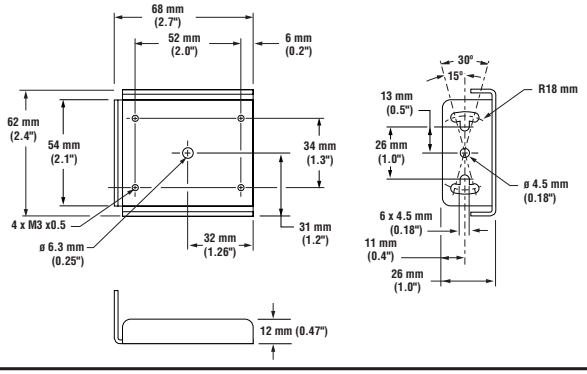
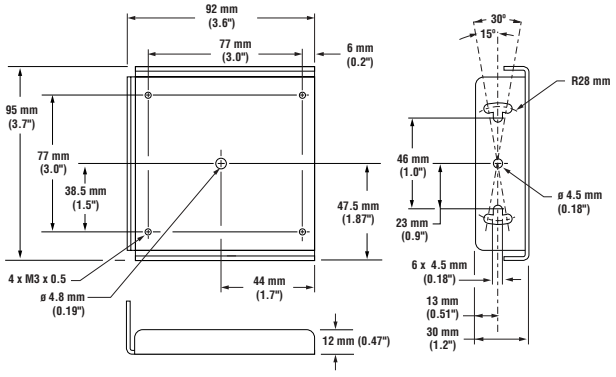
Style	Model	Wire Length	Used with:	Dimensions	Pin-out
3-Pin Male Pin-out	**MBC-3**	300 mm (12")	• MULTI-BEAM • MAXI-BEAM • Q85 series (emitters)	Side View 	Male Pinout 
4-Pin Male Pin-out	**MBC-4**	300 mm (12")	• MULTI-BEAM • MAXI-BEAM • Q85 series		Male Pinout 
5-Pin Male Pin-out	**MBC-5**	60 mm (2.5")	• Q85 series	Side View 	Male Pinout 

Brackets

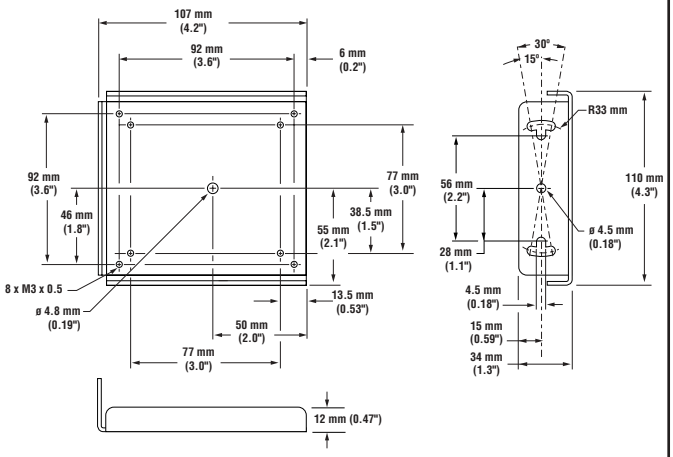
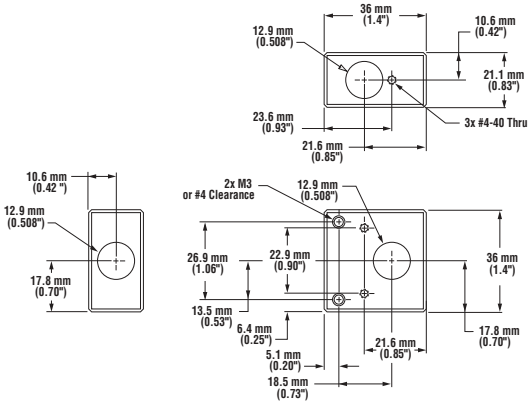
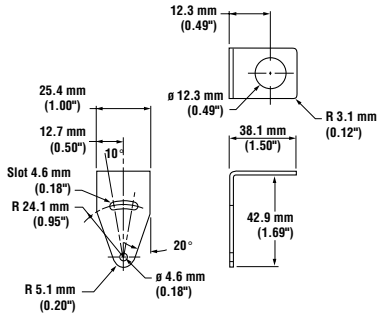
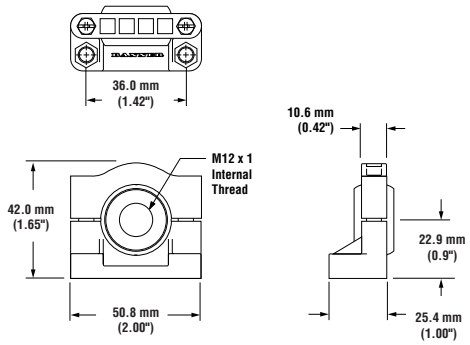
- Choose from a wide selection of sensor mounting brackets
- Most metal brackets are constructed of stainless steel
- Most non-metallic brackets are molded from reinforced thermoplastic polyester, including versatile swivel models

NOTE: See the accessories listing at the end of each product section for additional brackets which are designed specifically for one product family

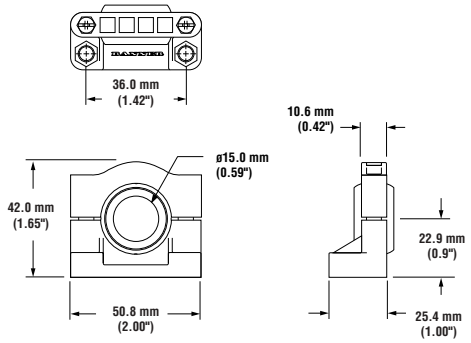
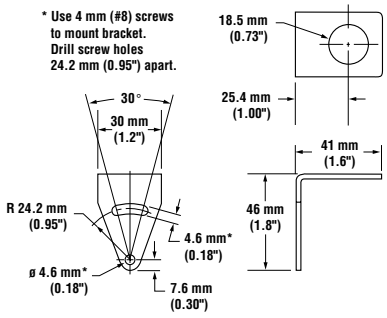
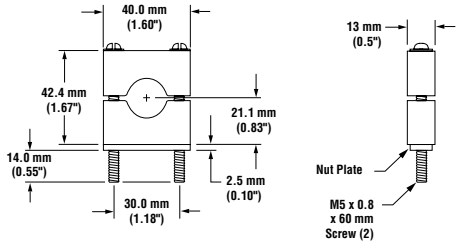
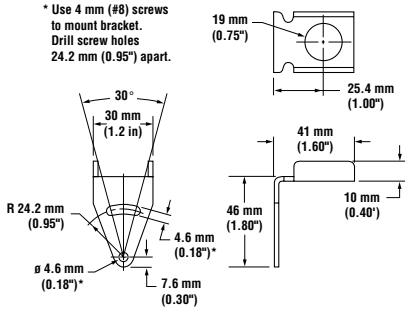
Mounting Brackets

Model	Description	Used with:	Dimensions
DIN-35-70 **DIN-35-105** **DIN-35-140** 	DIN-35-70: 70 mm (2.7") DIN-35-105: 105 mm (4.1") DIN-35-140: 140 mm (5.5")	• D12 • D11 • RS-11 socket • PICO-AMP	
RMB50 	• Protective mounting bracket for retroreflective targets • 14-gauge 316 stainless steel • Stainless steel M3 x 0.5 hardware is included	The following reflectors: • BRT-60X40C • BRT-2X2 • BRT-50D • BRT-50R	
RMB85 	• Protective mounting bracket for retroreflective targets • 14-gauge 316 stainless steel • Stainless steel M3 x 0.5 hardware is included	The following reflectors: • BRT-3 • BRT-77X77C	

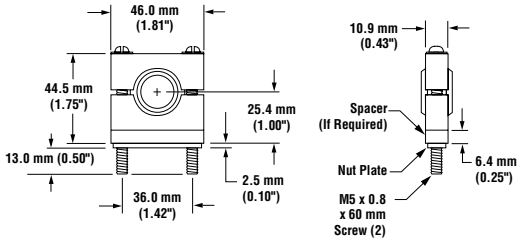
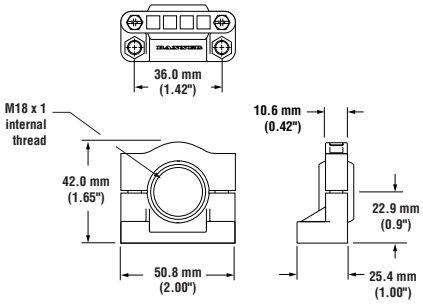
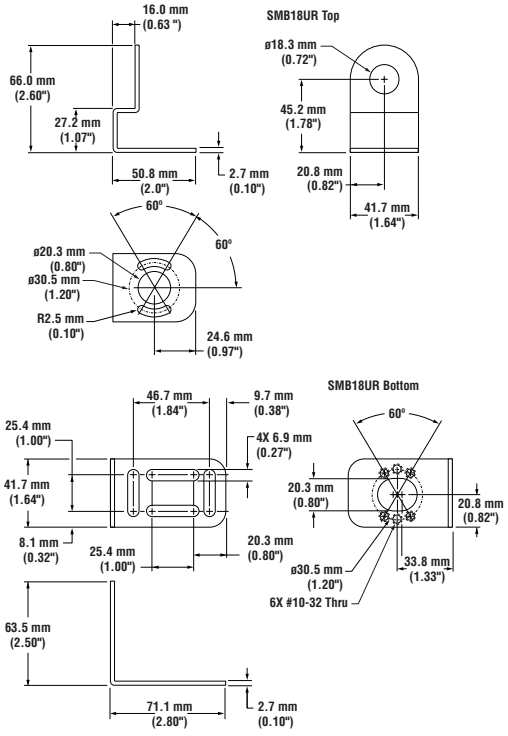
Mounting Brackets

Model	Description	Used with:	Dimensions
RMB100 	• Protective mounting bracket for retroreflective targets • 14-gauge 316 stainless steel • Stainless steel M3 x 0.5 hardware is included	The following reflectors: • BRT-92X92C • BRT-77X77C • BRT-3 • BRT-84	
SMB127 **Mounting Block** 	• Mounting block • Comes with: 3/64" hex wrench, 4 set screws	• M12 Laser emitters	
SMB12MM 	• 12-gauge, stainless steel, right angle mounting bracket for barrel style sensors with 12 mm threads • Curved mounting slot allows the bracket ±10° of lateral movement • Mounting holes accommodate M4 (#8) hardware	• S12 • SP12	
SMB1812SF 	• 12 mm swivel • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	• S12 • SP12	

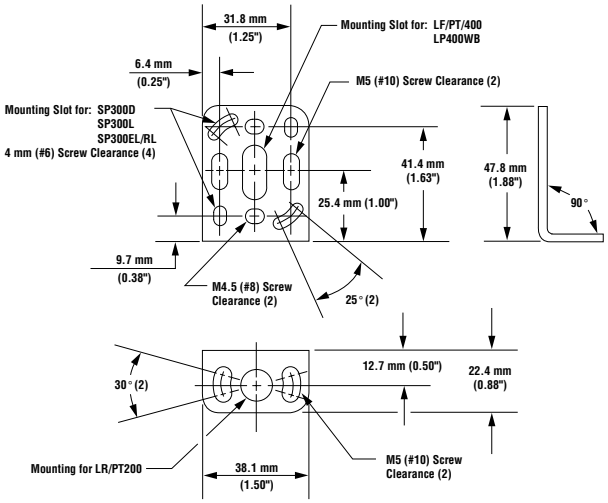
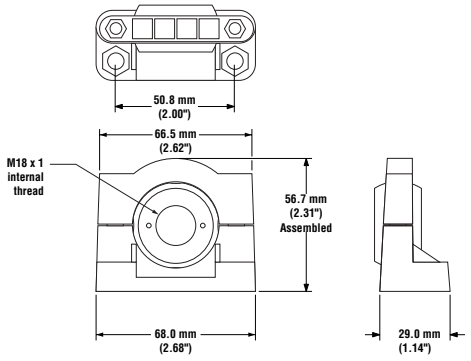
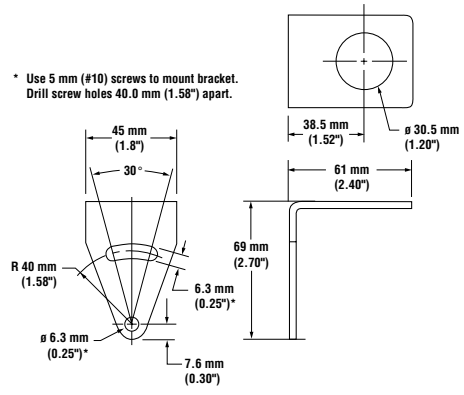
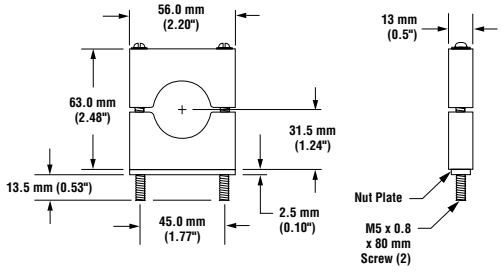
Mounting Brackets

Model	Description	Used with:	Dimensions
SMB1815SF 	• Swivel with set screws for mounting of T18 or T30 by its cable hub • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware and 3/64"3 hex wrench	• T18 • T30	
SMB18A 	• 12-gauge, stainless steel, right angle mounting bracket with a curved mounting slot for versatility and orientation • Clearance for M4 (#8) hardware	• MINI-BEAM • M18 • Q25 • S18 • T18 • QS18 (select models only)	
SMB18C 	• 18 mm split clamp bracket • Black thermoplastic polyester • Includes stainless steel mounting hardware	• MINI-BEAM • M18 • Q25 • S18 • T18	
SMB18Q 	• 18 mm angled flanged bracket for Q25 sensors • 12 ga stainless steel	• Q25	

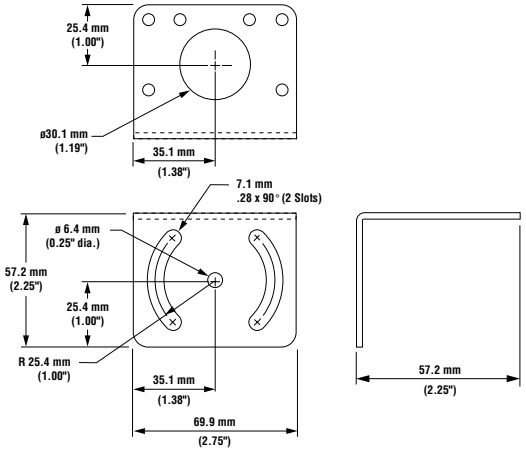
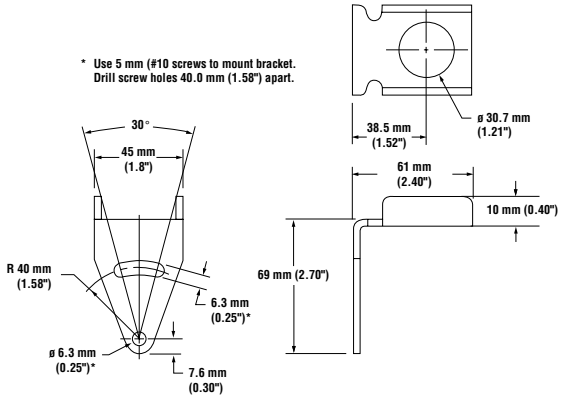
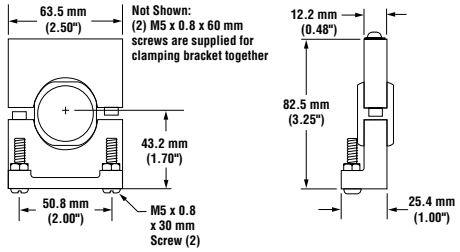
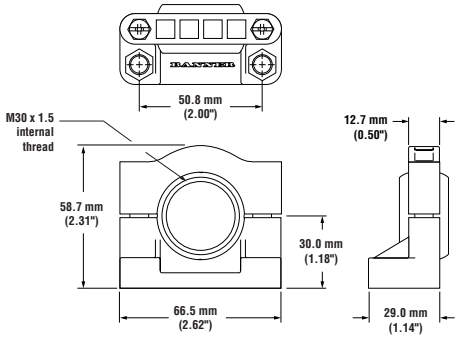
Mounting Brackets

Model	Description	Used with:	Dimensions
SMB18S 	• 18 mm swivel bracket • black thermoplastic polyester • Includes stainless steel mounting hardware	• MINI-BEAM • M18 • Q25 • S18 • T18	
SMB18SF 	• 18 mm swivel bracket • Black thermoplastic polyester • Includes stainless steel swivel locking hardware	• MINI-BEAM • M18 • Q25 • S18 • T18	
SMB18UR 	• 2-piece universal swivel bracket for 18 mm sensors • 300 series stainless steel • Includes stainless steel swivel locking hardware	• MINI-BEAM • M18 • S18 • T18	

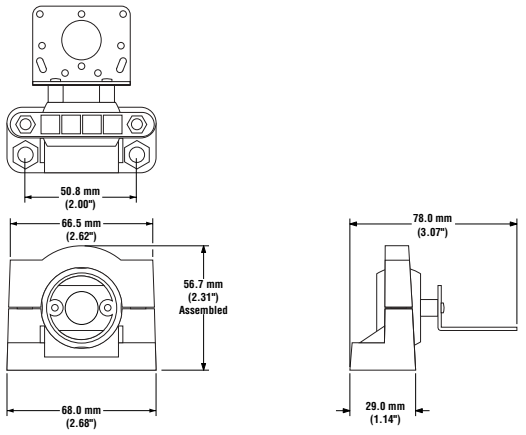
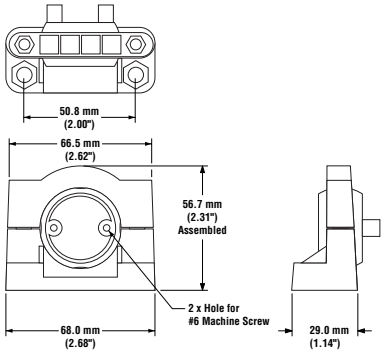
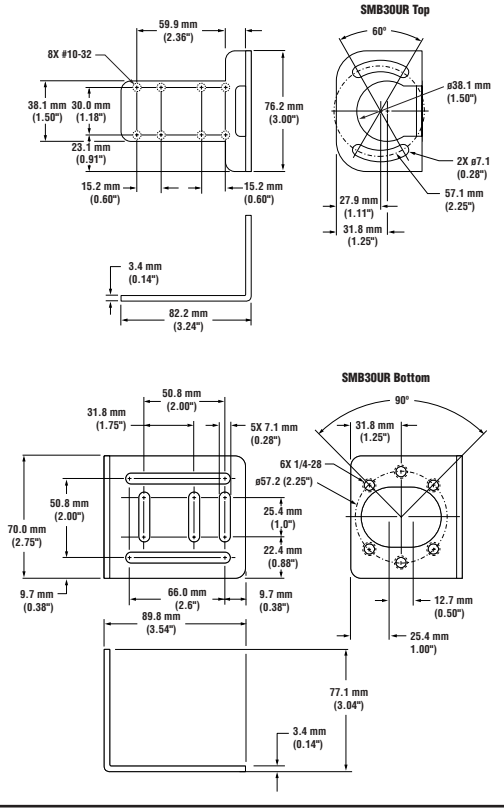
Mounting Brackets

Model	Description	Used with:	Dimensions
SMB300 	• Steel right angle bracket designed for 2-axis mounting • Clearance slot for mounting LR/PT400	• SP300 • LR/PT400 • LP400WB • LR/PT200	
SMB3018SC 	• 18 mm swivel barrel or side mount bracket • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	• MINI-BEAM • Q23 • QM42/QMT42 • Q25 • S18 • T18	
SMB30A 	• 12-gauge, stainless steel, right angle mounting bracket with a curved mounting slot for versatility and orientation • Clearance for M6 (1/4") hardware	• SM30 • Q40 • S30 • T30	
SMB30C 	• 30 mm split clamp bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting hardware	• OMNI-BEAM • Q45 • VALU-BEAM • SM30 • S30 • Q40 • T30 • OTB	

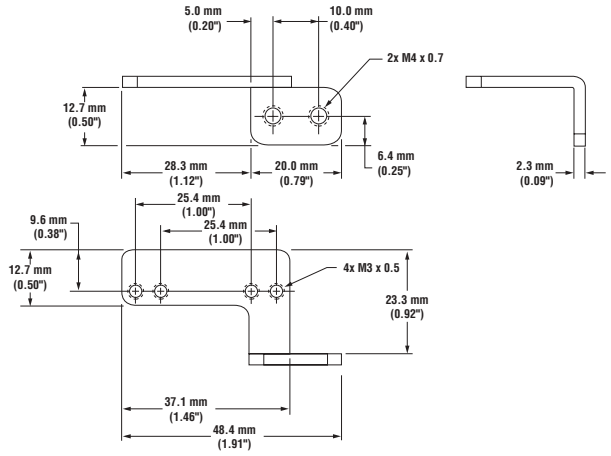
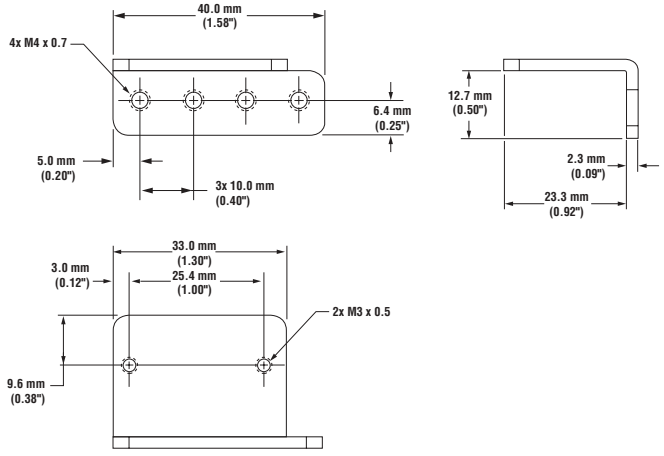
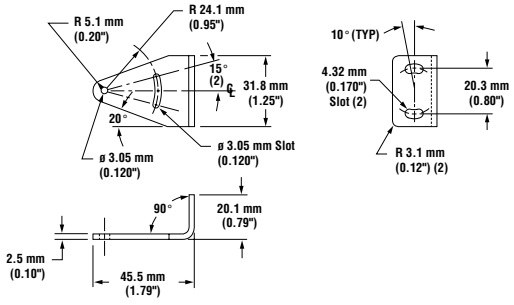
Mounting Brackets

Model	Description	Used with:	Dimensions
SMB30MM 	• 30 mm, 12-gauge, stainless steel bracket with curved mounting slots for versatility and orientation • Clearance for M6 (1/4") hardware	• OMNI-BEAM • Q45 • VALU-BEAM • SM30 • OTB	
SMB30Q 	• 30 mm angled flanged mounting bracket • Black reinforced thermoplastic polyester • Includes stainless steel hardware	• Q40	
SMB30S 	• 30 mm swivel bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting and swivel locking hardware	• OMNI-BEAM • Q45 • VALU-BEAM • SM30 • S30 • Q40 • T30 • OTB	
SMB30SC 	• 30 mm swivel bracket • Black reinforced thermoplastic polyester • Includes stainless steel mounting and swivel locking hardware	• OMNI-BEAM • Q45 • VALU-BEAM • SM30 • S30 • Q40 • T30 • OTB	

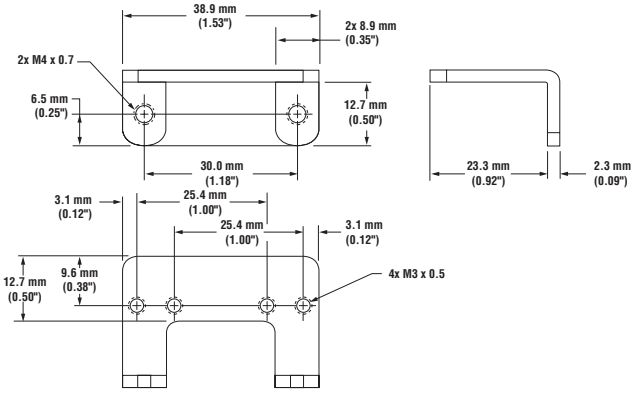
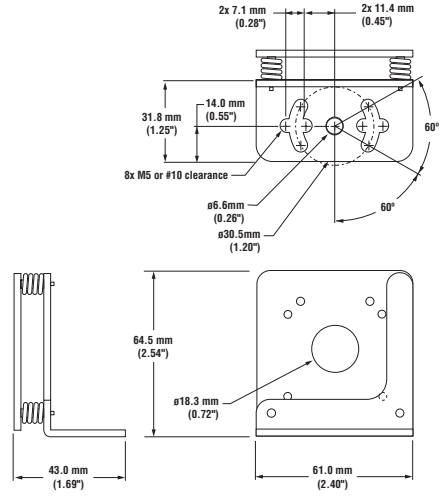
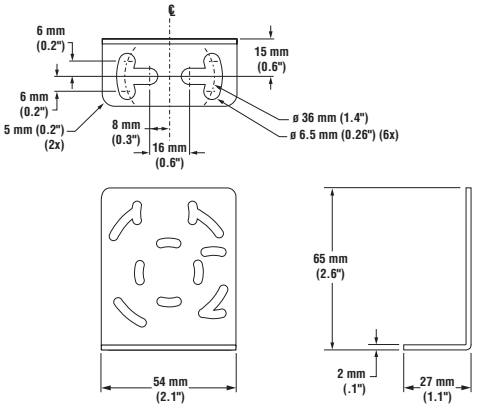
Mounting Brackets

Model	Description	Used with:	Dimensions
SMB30SK 	• Flat-mount swivel bracket with extended range of motion • Black reinforced thermoplastic polyester and 316 stainless steel • Includes stainless steel swivel locking hardware	• MINI-BEAM • Q23 • QM42/QMT42 • S18 • M18 • T18	
SMB30SUS 	• Side mount swivel bracket – extended range of motion • Black reinforced thermoplastic polyester • Includes stainless steel swivel locking hardware	• MINI-BEAM • Q23 • QM42	
SMB30UR 	• 2-piece universal swivel bracket for limit-switch style sensors • 300 series stainless steel • Includes stainless steel swivel locking hardware	• MULTI-BEAM • MAXI-BEAM • Q45 • OMNI-BEAM • LS10	

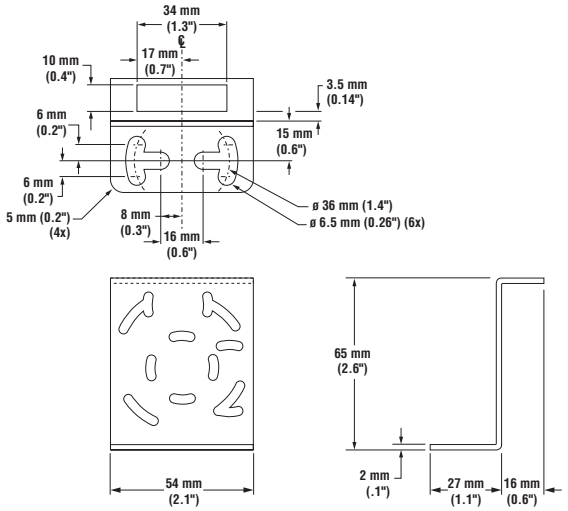
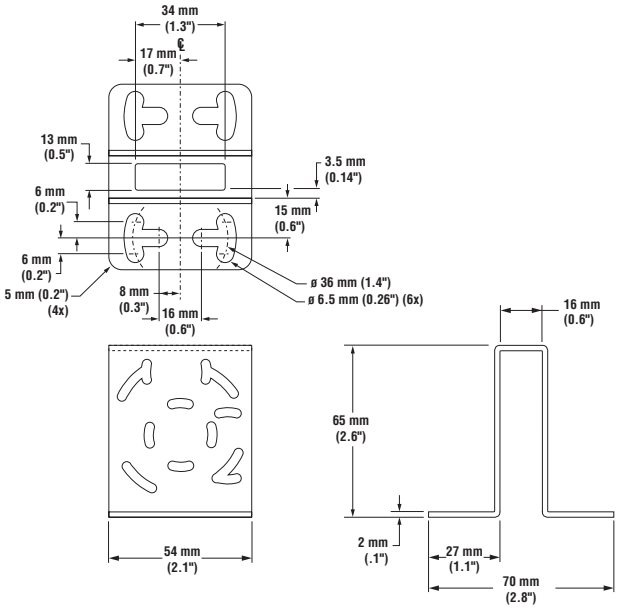
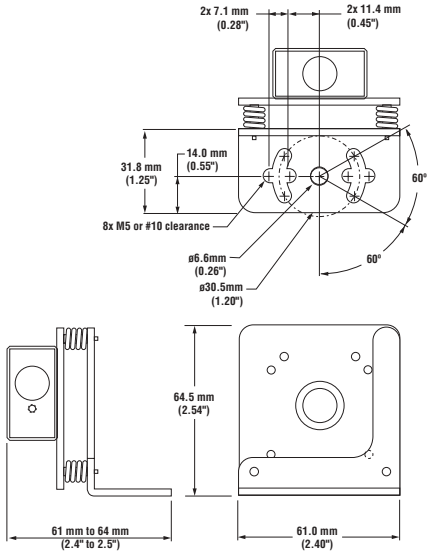
Mounting Brackets

Model	Description	Used with:	Dimensions
SMB42F 	• 13-gauge stainless steel • Includes mounting hardware	• QM42/QMT42	
SMB42L 	• 13-gauge stainless steel • Includes mounting hardware	• QM42/QMT42	
SMB42T 	• 2-axis side mounting bracket • Stainless steel • Includes M3 sensor mounting hardware	• QM42/QMT42	

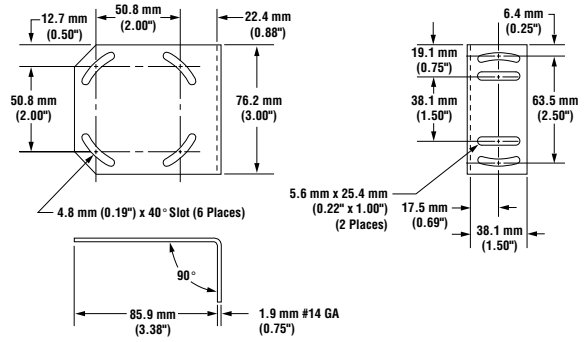
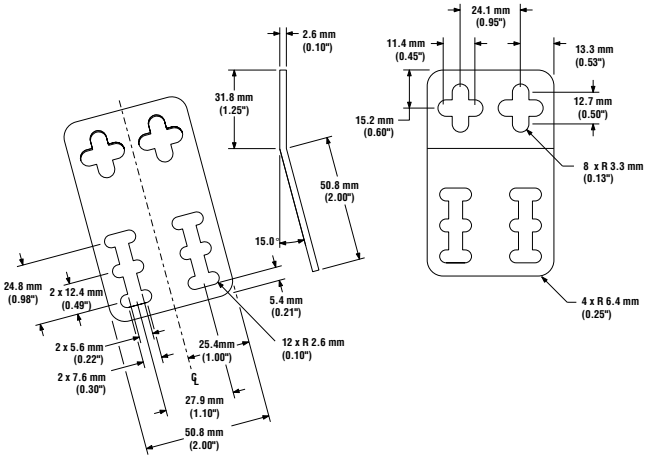
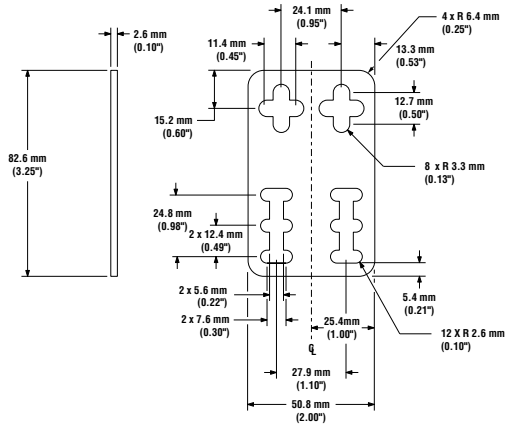
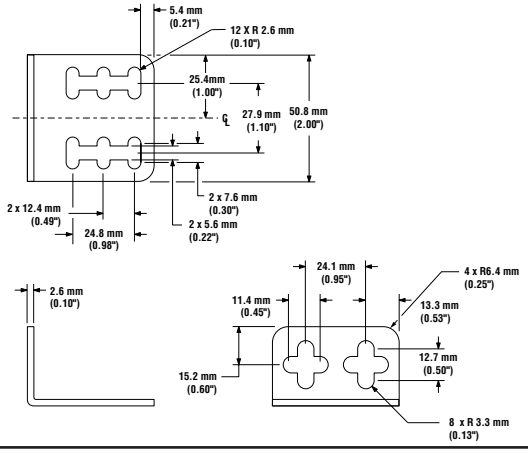
Mounting Brackets

Model	Description	Used with:	Dimensions
SMB42U 	• 13-gauge stainless steel • Includes mounting hardware	• QM42/QMT42	
SMB46A 	• 2-piece 12-gauge, stainless steel bracket assembly with precision sensor alignment adjustment • Includes 2 mm hex key	• S186ELD • PicoDot	
SMB46DF 	• "L" bracket • 14-gauge 316 stainless steel	• MINI-BEAM • PicoDot • Q23 Series • QM42/QMT42 • Q14	

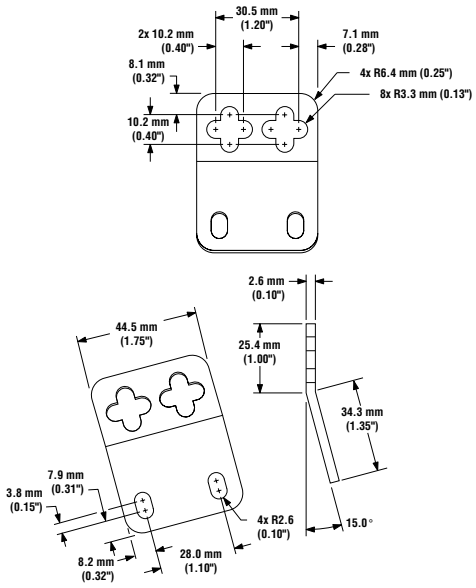
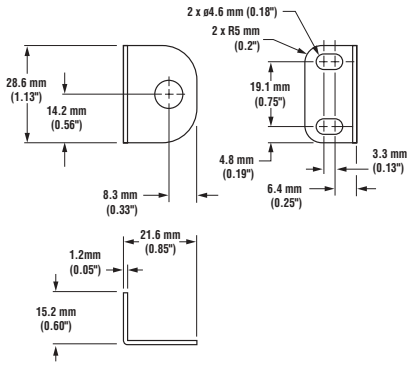
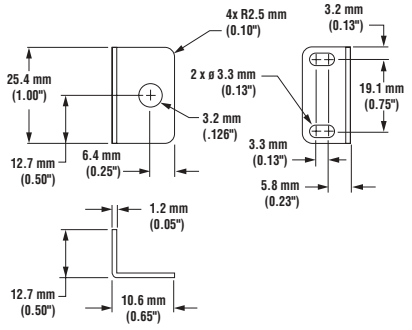
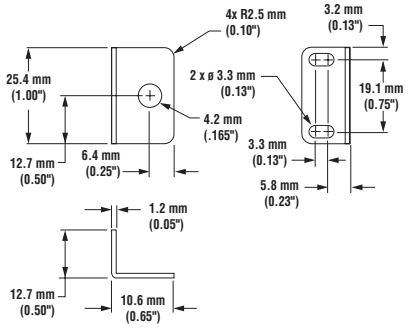
Mounting Brackets

Model	Description	Used with:	Dimensions
SMB46S 	• "S" bracket • 14-gauge 316 stainless steel	• MINI-BEAM • PicoDot • Q23/QH23 • QM42/QMT42 • Q14	
SMB46U 	• "U" bracket • 14-gauge 316 stainless steel	• "U" bracket • 14-gauge 316 stainless steel	
SMB46X3 	• Assembly with mounting block and adjustable bracket • Includes: - 2 mm hex key - $^{3}/_{64}$" hex key 4 set screws	• M12 Laser emitters	

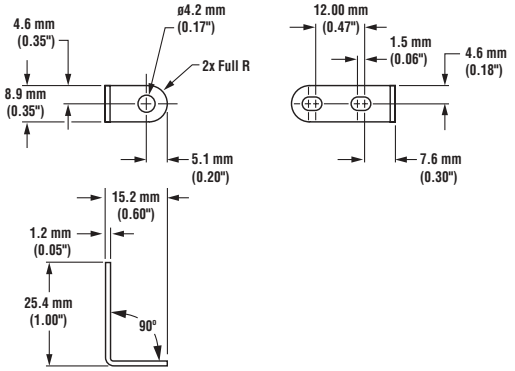
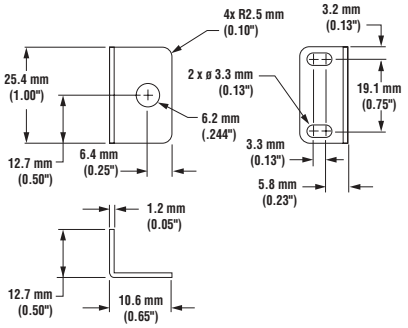
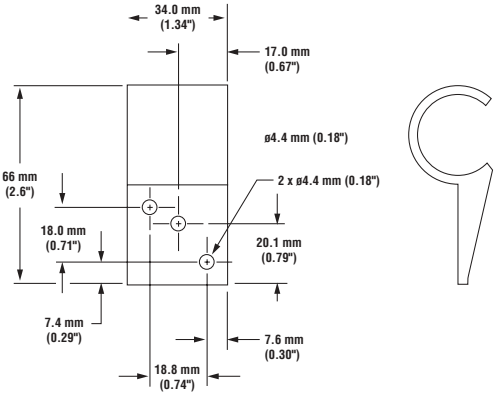
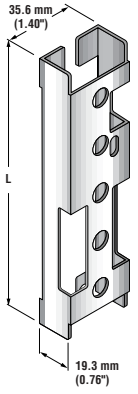
Mounting Brackets

Model	Description	Used with:	Dimensions
SMB500 	• Universal steel mounting bracket	• SM512	
SMB55A 	• 15° offset bracket • 12-gauge stainless steel	• R55	
SMB55F 	• Flat mount bracket • 12-gauge stainless steel	• R55	
SMB55RA 	• 90° offset bracket • 12-gauge stainless steel	• R55	

Mounting Brackets

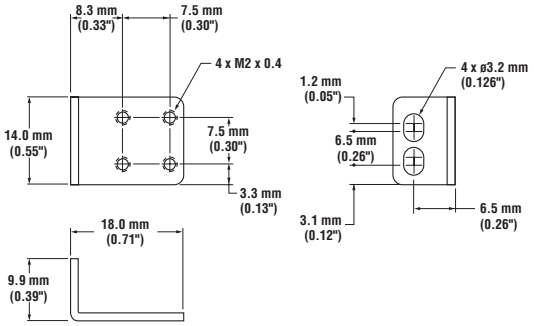
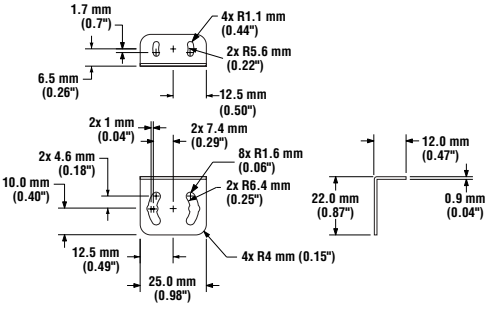
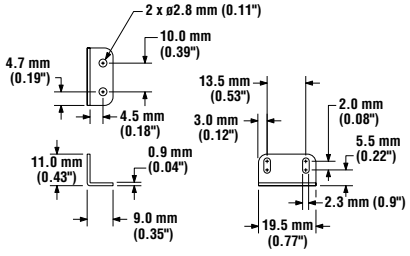
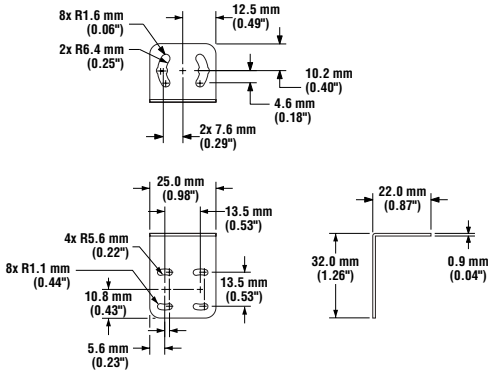
Model	Description	Used with:	Dimensions
SMB55S 	• 15° offset bracket • 12-gauge stainless steel	• R55	
SMBF 	• Right angle bracket for glass fiber optics with $^{5}/_{16}$" - 24 threaded tip • 18-gauge stainless steel	• Glass fiber with $^{5}/_{16}$" - 24 tip	
SMBFP3 	• Right angle bracket for plastic fiber optics with 3 mm threaded tip • 18-gauge stainless steel	• Plastic fiber with M3 tip	
SMBFP4 	• Right angle bracket for plastic fiber optics with 4 mm threaded tip • 18-gauge stainless steel	• Plastic fiber with M4 tip	

Mounting Brackets

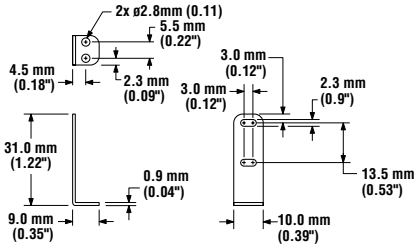
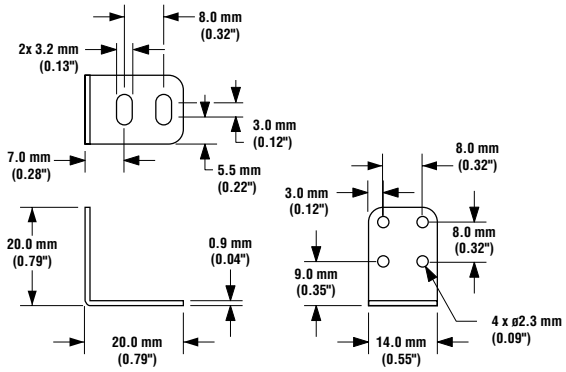
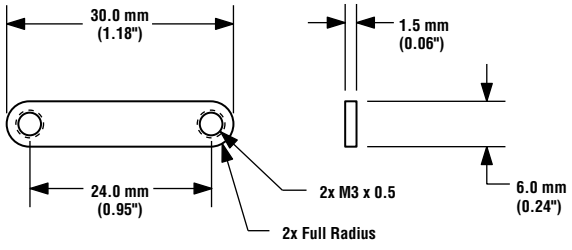
Model	Description	Used with:	Dimensions
SMBFP4N 	• Low profile bracket for plastic fiber optics with 4 mm threaded tip • 18-gauge stainless steel	• Plastic fiber with M4 tip	
SMBFP6 	• Right angle bracket for plastic fiber optics with 6 mm threaded tip • 18-gauge stainless steel	• Plastic fiber with M6 tip	
SMBPVA2 	• Set of 4 molded brackets • Snaps onto standard 28 mm diameter pipe • 2 required per PVA sensor	• PVA	
SMBPVA5 **SMBPVA10** **SMBPVA13** **SMBPVA16** 	• Set of 2 heavy-duty protective brackets for PVA sensors • Cold-rolled plated steel	• PVA	

Model	Used With	"L"
SMBPVA5	PVA100	139.7 mm
SMBPVA10	PVA225	268.2 mm
SMBPVA13	PVA300	343.3 mm
SMBPVA16	PVA375	418.2 mm

Mounting Brackets

Model	Description	Used with:	Dimensions
SMBSP3 	• Right angle bracket • Stainless steel	• SP3 • SP8	
SMBVS1S 	• Short bracket • 18-gauge stainless steel	• VS1	
SMBVS1SC 	• Short bracket • 18-gauge stainless steel	• VS1	
SMBVS1T 	• Tall bracket • Stainless steel	• VS1	

Mounting Brackets

Model	Description	Used with:	Dimensions
SMBVS1TC 	• Tall compact bracket • 300 Stainless steel	• VS1	
SMBVS2RA 	• Right-angle bracket • Stainless steel	• VS2	
SMH241F 	• Nut strap replaces two M3 mounting nuts and washers • 16-gauge stainless steel	• MINI-BEAM • Q23 • QM42/QMT42	

BT-1 BEAM-TRACKER

Wireless Photoelectric Diagnostics Sensor

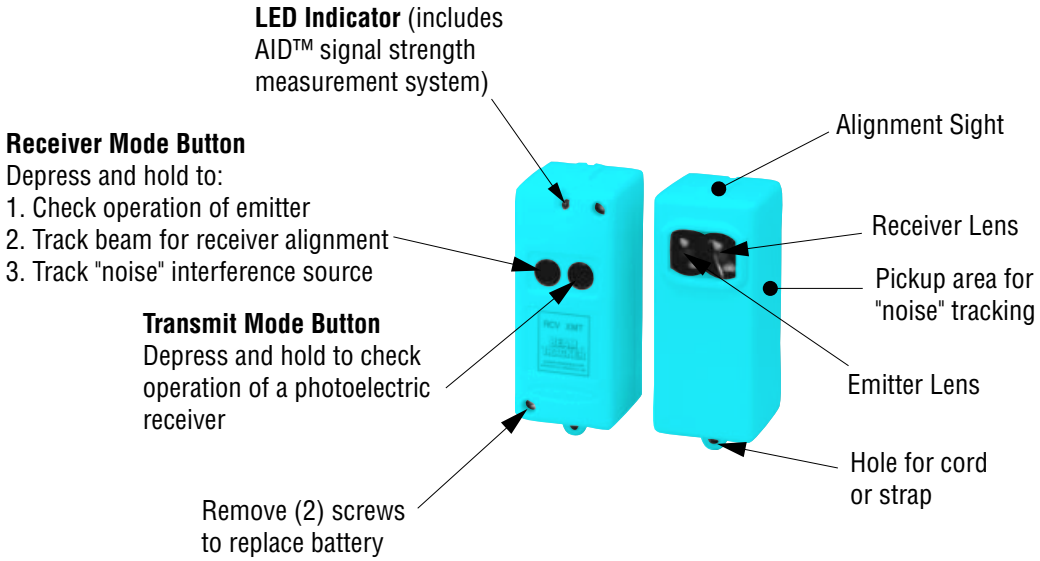
- A quick and simple way to evaluate photoelectric system performance
- Receives light from all modulated photoelectric emitters and transmits light to receivers to check system operation
- Built-in high frequency emitter that will be detected by any Banner photoelectric receiver, as well as by those of most other photoelectric manufacturers
- A valuable tool for locating the center of the beam when installing long-range opposed mode photoelectric sensor pairs
- Locates sources of severe EMI or RFI "noise"
- Low cost, battery operated, and completely self-contained

BT-1 BEAM TRACKER Specifications

Model Number	BT-1
Supply Voltage and Current	9V battery which provides about 10 hours of continuous use (or, typically hundreds of tests)
Indicators	Exclusive, patented Alignment Indicating Device system (AID™, US patent #4356393) which displays the relative strength of the light which it receives from a modulated source. When the receive button is depressed, an LED indicates the presence of a modulated light beam and flashes at a rate which corresponds directly to the beam's intensity. As a result, a suspected weak or failed light source is easily verified.
Beam	BEAM TRACKER emits a 70kHz modulated infrared beam Most modulated photoelectric receivers, if functioning properly, will respond to this beam at close range.
Construction	Housed in a rugged Cycolac T® case, which includes an aiming sight, plus a convenient mounting hole for a strap or cord. Totally self-contained.
Application Notes	In the receive mode, the BEAM TRACKER will respond to a severe level of electromagnetic or radio frequency interference. The path of the "noise" source can be traced by observing the flash rate of the BEAM TRACKER's Alignment Indicating Device.

Cycolac® is a registered trademark of General Electric Co.

BT-1 BEAM-TRACKER Features



LAT-1 Laser Alignment Tool

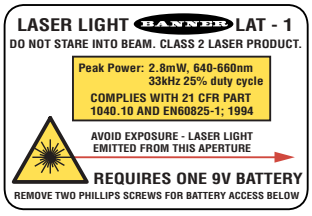
Visible Laser Device for Aligning Light Screen Systems

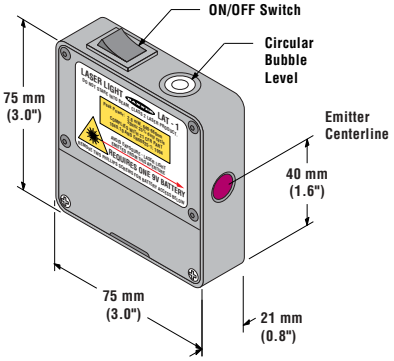
- Totally self-contained visible-beam laser tool simplifies the alignment of any opposed-mode sensor pair
- Uses one common 9-volt battery (included)
- Built-in circular bubble level
- Retroreflective target material included for easy viewing of the laser spot at long distances

LAT-1 Laser Alignment Tool Specifications

Supply Voltage and Current	One standard 9V battery, included (replaceable); approximately 20 hours of continuous operation
Sensing Beam	Class 2 laser, 640-660 nm visible red IEC **Pulse Width:** 7µs **Rep rate:** 30µs **Peak output power:** 2.8 mW, 33kHz, 25% duty cycle
Beam Size at Aperture	Approximately 2 mm (0.08") diameter
Beam Divergence	± 1.0 milliradian within specified temperature range ± 0.5 milliradians at room temperature
Beam Placement	Within ± 4 milliradians (approximately ±0.25 degrees) of parallel to front, back, top and bottom of housing
Construction	Aluminum housing; black anodized finish Black polypropylene cover with flexible hinge for battery access
Environmental Rating	NEMA 1; IEC IP50
Operating Conditions	**Temperature:** 0° to +40°C (+32° to 104°F) **Maximum Relative Humidity:** 90% @ +50°C (non-condensing)
Laser Classification	U.S. Safety Standards 21 CFR 1040.10 European Standards EN 60825-1:1994

LAT-1 Laser Alignment Tool Dimensions and Features





DBQ5 Portable Demo Box

- Used to power dc self-contained photoelectric sensors for testing purposes
- Designed around the 4-pin euro-style connector
- Powered by three standard 9V batteries (27V dc) for very long service life
- Features bi-color LEDs which indicate not only sensor output status, but also output type (NPN or PNP)
- Cable adapters are available to convert to pico-style or mini-style connectors
- A 4-pin wiring barrier is mounted on the top of the box to allow connection of cabled dc sensors

Demo Box

Model	Dimensions
DBQ5	114 mm wide x 62 mm deep x 47 mm high (4.5" x 2.4" x 1.9")

Cable Adapters

Part Number	Type	Used for:
39536	Euro-to-pico	D11, D12, Q23, S12, MINI-BEAM2 and PICO-AMP series sensors
39537	Euro-to-mini	VALU-BEAM, Q45 series, SM30 dc series OPTO-TOUCH and OMNI-BEAM sensors

SPS100 DC Sensor Power Supply

- Converts 120V ac line voltage to low voltage dc for powering any Banner dc sensor† which has either 4- or 5-pin Euro-style quick-disconnect (QD)
- SPS100 models include 5 amp-rated SPDT relay for switching ac loads or large dc loads
- SPS100S models include an optically-isolated SPST solid-state output for switching ac or dc loads
- Models with "Q" suffix require a sensor with a pigtail QD connector; models with "QP" suffix connect to a sensor with either an integral or pigtail quick-disconnect

† Note: SPS power supplies are not for use with NAMUR sensors or personal safety products.

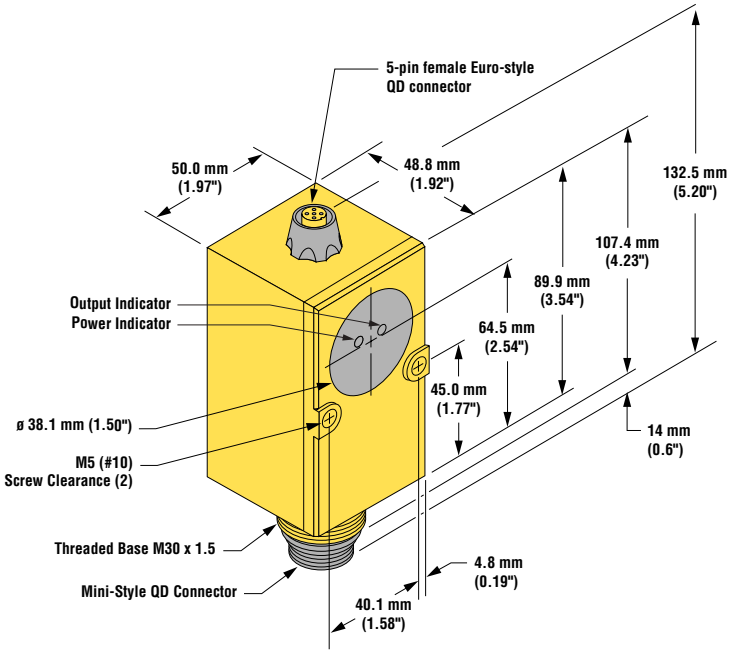
SPS100 Sensor Power Supply Models

Model	Supply Voltage	Sensor Connection	Supply/Output Cable	Output Type
SPS100Q	105-130V ac 60 Hz	5-pin Euro-style QD*	5-pin Mini QD	"Form C" (SPDT) electromechanical relay (see specifications for rating information)
SPS100QP		5-pin Pigtail Euro-style QD		
SPS100SQ		5-pin Euro-style QD*	4-pin Mini QD	SPST Optically-isolated solid-state switch (see specifications for rating information)
SPS100SQP		5-pin Pigtail Euro-style QD		

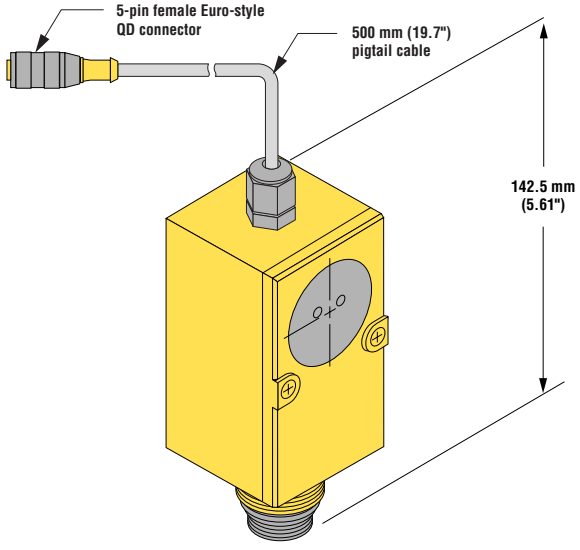
*Requires 4- or 5-pin Pigtail Euro QD on sensor.

SPS100 Sensor Power Supply Dimensions

Model Suffix "Q"



Model Suffix "QP"

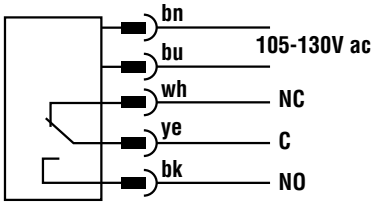


SPS100 Sensor Power Supply Specifications

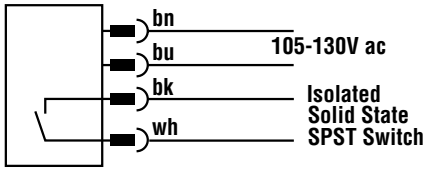
Supply Voltage	105V ac to 130V ac, 60Hz
Output Power	120mA maximum: 12V dc minimum, 30V dc maximum (dependent on load)
Output Configuration	**SPS100Q(P) models:** "Form C" (SPDT) electromechanical relay **SPS100SQ(P) models:** Optically isolated SPST solid-state switch
Output Rating	**SPS100Q(P) models:** Max. switching power (resistive load) = 150 W, 600 VA Max. switching voltage (resistive load) = 250V ac or 30 V dc (120V ac max. per UL & CSA) Max. switching current (resistive load) = 5A Min.. voltage and current = 1 amp at 5V dc, 0.1 amp at 24V dc Peak switching voltage = 750V ac (transient suppression recommended) Mechanical life of relay = 10,000,000 operations **SPS100SQ(P) models:** Max. switching voltage = 250V ac or 250V dc Max. switching current = 150mA at 25°C, derated to 80 mA at 50°C On-state saturation voltage = less than 3V at 150 mA; less than 1V at 10 mA
Status Indicators	Power On (green) and Output On (red)
Connections	Power connector: **SPS100Q(P) models:** 5-pin Mini-style quick disconnect **SPS100SQ(P) models:** 4-pin Mini-style quick disconnect Sensor connector: **"Q" version:** 5-pin Euro-style quick-disconnect mounted on housing **"QP" version:** PVC jacketed 5-pin pigtail Euro-style quick-disconnect 0.5 meter long
Environmental Rating	IEC IP54
Operating Conditions	**Temperature:** -20° to +50°C (-20° to 122°F) **Maximum Relative Humidity:** 90% @ +50°C (non-condensing)
Additional Notes	Compatible with Banner dc sensors with NPN or PNP output, equipped with 4- or 5-pin Euro-style quick-disconnect (except NAMUR sensors). **Model SPS100Q:** connects only to sensors equipped with a pigtail Euro-style quick-disconnect **Model SPS100QP:** connects to sensors equipped with either a pigtail or sensor-mounted Euro-style quick-disconnect **Model SPS100SQ:** connects only to sensors equipped with a pigtail Euro-style quick-disconnect **Model SPS100SQP:** connects to sensors equipped with either a pigtail or sensor-mounted Euro-style quick-disconnect

SPS100 Sensor Power Supply Hookups

SPS100 Mechanical Relay



SPS100 Solid-State Relay



Quick-Disconnect (QD) Cables

Following is the selection of cables available for SPS100 models. See the Accessories on page 726 for more information.

Style	Model	Length	Connector	Used with:
4-Pin Mini	**MBCC-406** **MBCC-412** **MBCC-430**	2 m (6.5') 4 m (12') 9 m (30')	Straight	SPS100SQ, SPS100SQP
5-Pin Mini	**MBCC-506** **MBCC-512** **MBCC-530**	2 m (6.5') 4 m (12') 9 m (30')	Straight	SPS100Q, SPS100QP

NOTES:

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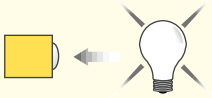
Understanding Sensing Terms

Data Reference Tables

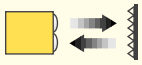
Other Banner Products

International Distributor List



AMBIENT LIGHT RECEIVERS: Ambient light receivers, such as MULTI-BEAM model SBAR1, are operated by sunlight, room light, or laser light sources. These sensors are also used to sense the large amounts of infrared light (heat energy) emitted by hot or molten glass, metal, or plastic during processing of these materials.

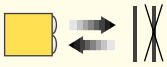
OPPOSED (A.K.A. "THROUGH-BEAM") SENSING MODE: The opposed mode requires a separate emitter and receiver that are positioned opposite each other so that the light from the emitter shines directly on the receiver. An object is sensed when it interrupts the light beam. The opposed mode is the most efficient use of photoelectric sensing energy, and offers the highest level of excess gain for reliable sensing through dirt, fog, or other challenging environments.



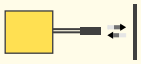
RETROREFLECTIVE (A.K.A. "RETRO") SENSING MODE: Retroreflective mode sensors have both the emitter and the receiver in the same housing. A light beam is established between the sensor and a special retroreflective target (see page 722). An object is sensed when it interrupts the light beam. Retro is the most popular sensing mode for conveyor control and similar applications where there is an advantage to have a sensor on only one side of the sensing process. Polarized retroreflective sensors are used when the object to be detected is highly reflective. Special laser retro sensors, such as Q45LL (page 382), offer very long range and accurate sensing repeatability.

DIFFUSE (A.K.A. "PROXIMITY") SENSING MODE: Diffuse mode sensors contain both the emitter and the receiver in the same housing. An object is detected when the receiver captures the small percentage of emitted light that is reflected back to the sensor from the surface of the object itself. Minimal lensing is used so as to project the emitted light in a broad (diffused) pattern and give the receiver a wide field of view. Special models called divergent mode sensors use no lenses at all for extremely forgiving alignment to objects that are difficult for reflective sensors to sense, such as clear materials and very small parts.

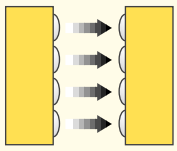
CONVERGENT BEAM SENSING MODE: The convergent mode is similar to the diffuse sensing mode because an object is sensed when the receiver sees light reflected back to the sensor by the object itself. Unlike diffuse mode sensors, however, convergent sensors use additional optics to produce a small and well-defined sensing area, focused at a fixed point ahead of the sensor lens. Because convergent sensors make much more efficient use of sensing light energy, they can sense relatively non-reflective materials and objects with small reflective surfaces. They are, however, much less forgiving to sensing distance, as compared to diffuse mode sensors.

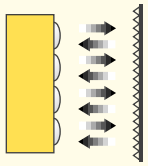


FIXED-FIELD AND ADJUSTABLE FIELD SENSING MODES: Fixed-field sensors use two receivers and a comparator circuit to cancel sensing response whenever the intensity of the reflected light reaching the long-range receiver exceeds the intensity of the reflected light reaching the close-range receiver. As a result, any object lying beyond the sensor's fixed "cutoff point" can be reliably ignored. Adjustable field sensors use an array of multiple receiver elements, which allows the sensor circuitry to move the locations of the cutoff point with a simple adjustment.

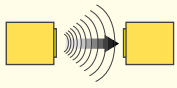


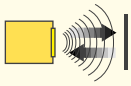
FIBER OPTIC SENSING MODES: Transparent fibers of glass or plastic may be used for conducting and guiding photoelectric sensing light energy. Individual fibers are usually used in pairs for opposed mode sensing. Bifurcated fibers combine the emitted and received light in the same assembly, and are usually used for diffuse mode sensing. Bifurcated fiber optics are sometimes fitted with an optional lens for retroreflective mode sensing. Fiber optics comprise the smallest photoelectric sensors and can fit into extremely tight spaces. Most glass fiber optics are able to withstand sensing environments where there are corrosive materials and/or where the temperature is too high for sensor electronics. Most sensor families include models for use with fiber optics.



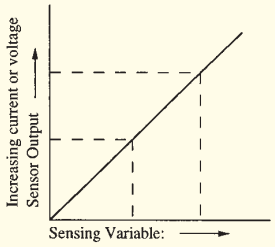


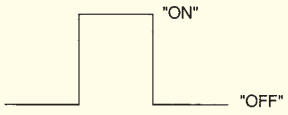
LIGHT SCREENS (A.K.A. LIGHT CURTAINS): A light screen is an array of photoelectric beams configured to sense objects passing anywhere through an area (i. e. - through a sensing plane). Some light screens, such as MINI-ARRAY or BEAM-ARRAY™ models work together with a microprocessor-based controller to measure and/or profile one dimension of an object that passes through the sensing plane (See the Banner Measurement and Inspection Sensor Catalog). Other light screens, such as LS Series sensors (page 526), are designed simply for sensing the presence of a part in the sensing plane, and are usually used for parts counting or die ejection verification. Safety light screens, such as the MINI-SCREEN®, include the necessary self-checking redundant circuitry necessary to allow their use in personnel safety applications. See the Banner Machine Safety Products Catalog and the "Important Safety Warning" inside the front cover of this catalog.

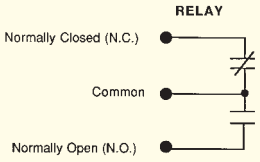


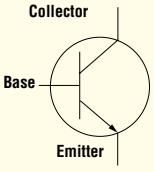


ULTRASONIC SENSING MODES: Ultrasound may be used for opposed mode or reflective proximity mode detection of clear materials and other objects that are difficult to detect with photoelectric sensors. Ultrasonic proximity mode sensors measure the time delay between the emitted sound and the returned echo, and produce an accurate measurement of sensing distance. Ultrasonic analog proximity sensors produce an output that has a highly linear relationship to sensing distance. Ultrasonic proximity sensors with switched outputs, such a OMNI-BEAM™ and Q45U models, offer a "high/low level" mode that can directly control fill level of liquids or solids. (See the Banner Measurement and Inspection Sensor Catalog)







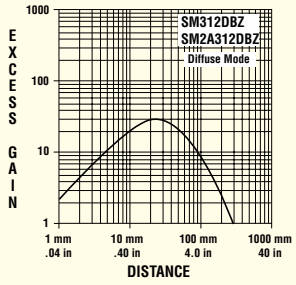


ANALOG RESPONSE: Most sensors offer a switched (discrete) output. Sensors with an analog output produce a variable voltage or current that is proportional to some sensing parameter. The output of an analog photoelectric sensor is proportional to the strength of the received light signal (see Analog OMNI-BEAM™ sensors, page 444). The output of an analog ultrasonic proximity mode sensor is proportional to the distance from the sensor to the object that is returning the sound echo. (See the Banner Measurement and Inspection Sensor Catalog)

SWITCHED (A.K.A. DISCRETE OR BINARY) OUTPUT: Most sensors are used for presence sensing and offer a relay as an output switching device. The relay switch is always in either one of two states: open or closed ("ON" or "OFF").

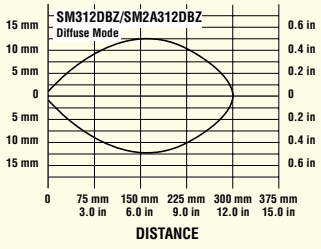
ELECTROMECHANICAL ("E/M") RELAYS offer one or more "hard" contacts (metal-to-metal) and are switched to the opened or closed position by applying voltage to an electromagnetic coil. E/m relays can switch the highest power levels. They are limited by slow switching speed and a finite mechanical life.

SOLID-STATE RELAYS use switching elements such as transistors for dc loads and SCRs or FETs for ac loads. Solid-state relays offer fast switching speed and infinite life. They are limited by their power ratings, and are protected in most sensors against damage from overload by additional circuitry.



EXCESS GAIN: Excess gain is a photoelectric sensor specification. It is a measurement of the amount of light falling on the receiver over and above the minimum amount of light required to just operate the sensor's amplifier. Excess gain is plotted versus sensing distance. Excess gain values are used to predict the reliability of a photoelectric sensor operating in a known sensing environment (see, below).

Excess Gain Guidelines	
Operating Environment	**Excess Gain Required**
CLEAN AIR: No dirt buildup on lenses or reflectors	1.5
SLIGHTLY DIRTY: Slight buildup of lint, paper, dust, moisture, or film on lenses or reflectors; lenses cleaned regularly	5
MODERATELY DIRTY: Obvious contamination of lenses and reflector, but not obscured; lenses cleaned occasionally or when necessary	10
VERY DIRTY: Heavy contamination of lenses; fog, mist or dust; minimal cleaning of lenses	50 or more



BEAM PATTERN: Beam patterns are two-dimensional plots of sensor response versus sensing distance. They can be helpful in predicting sensor performance. A beam pattern for an opposed mode sensor pair represents the boundary within which the receiver will effectively "see" the emitted light beam, assuming no angular misalignment between the emitter and receiver. Retroreflective beam patterns are plotted using a model BRT-3 retroreflective target. Diffuse and convergent mode beam patterns represent the boundary within which the edge of 200 x 250 mm (8 x 10 in) Kodak 90% reflectance white test card is detected as it moves into the sensing area. A beam pattern is affected by many sensing variables, and should be considered as a guideline and not as an exact specification.

ENVIRONMENTAL RATING: Banner sensors and modules are rated for their suitability for use in various sensing environments using two rating systems: National Electrical Manufacturers Association (NEMA) and The International Electrotechnical Commission (IEC).

NEMA Standards Publication No. 250 guidelines are outlined:

NEMA 1	Indoor Use	Protects against accidental contact by personnel & falling dirt
NEMA 2	Indoor Use	Protects against falling dirt, liquid & light splash
NEMA 3	Outdoor Use	Protects against rain, sleet, snow, dirt & dust
NEMA 3S	Outdoor Use	Protects against rain, sleet, snow, dirt, dust & ice buildup
NEMA 4	In- or Outdoor	Protects against dirt, dust, hosedown (and heavy splash)
NEMA 4X	In- or Outdoor	Protects against dirt, dust, hosedown & corrosion
NEMA 6	In- or Outdoor	Protects against dirt, dust, hosedown & occasional submersion
NEMA 6P	In- or Outdoor	Protects against dirt, dust, hosedown & prolonged submersion
NEMA 7	Indoor Use	For use in areas of explosive gases or vapors or combustible dust
NEMA 9	Indoor Use	For use in areas of atmospheres containing combustible dust
NEMA 12	Indoor Use	Protects against dirt, dust, light splash & oil or coolant seepage
NEMA 13	Indoor Use	Protects against dirt, dust, light splash & oil or coolant spray

The rating system established by IEC Publications 144 and 529 define the following "IP" ratings:

1ST CHARACTERISTIC: Protection against contact and penetration of solid bodies

Numeral	Short Description
0	Non-protected
1	Protected against solid objects greater than 50 mm
2	Protected against solid objects greater than 12 mm
3	Protected against solid objects greater than 2.5 mm
4	Protected against solid objects greater than 1.0 mm
5	Dust protected
6	Dust-tight

2ND CHARACTERISTIC: Protection against the penetration of liquids

Numeral	Short Description
0	Non-protected
1	Protected against dripping water
2	Protected against dripping water when tilted up to 15°
3	Protected against spraying water
4	Protected against splashing water
5	Protected against water jets
6	Protected against heavy seas
7	Protected against the effects of immersion
8	Protected against submersion

INTRINSICALLY-SAFE (A.K.A. "I.S.") SENSORS: Intrinsic safety is a design technique applied to electrical equipment, including sensors, for use in hazardous (explosive) locations. The technique involves limiting electrical and thermal energy to a level below that required to ignite a specific hazardous atmosphere. I.S. sensors are used with intrinsic safety barriers, which are protective components designed to limit the voltage and current within the hazardous atmosphere. See the SMI912 Series, page 356 and the SMI30 Series, page 290.

NAMUR SENSORS: NAMUR photoelectric sensors are 2-wire devices that change their internal resistance relative to the intensity of the received light. They are designed for use with certified switching amplifiers with intrinsically-safe circuits, which convert this change to a binary output signal. NAMUR sensors are most commonly used in hazardous (explosive) sensing environments. See the Q45AD9 Series, page 414 and the MIAD9 Series, page 146.

TABLE 1. Units for Photoelectric Specifications

Unit	Symbol	Physical Quantity
ac volts	V ac	electrical potential – alternating current
ampere	A	electrical current
dc volts	V dc	electrical potential – direct current
degrees Celsius	°C	temperature (see Table 8)
degrees Fahrenheit	°F	temperature (see Table 8)
Hertz	Hz	frequency
lumen*	lm	light energy
lux	lx	illumination (lm/m^2)
meter	m	length
microamp	µA	electrical current (10^{-6} A)
microsecond	µs	time (10^{-6} s)
milliamp	mA	electrical current (10^{-3} A)
millimeter	mm	length (10^{-3} m)
millisecond	ms	time (10^{-3} s)
nanometer	nm	length (light wavelength)
ohm	Ω	electrical resistance
second	s	time
volt	V	electrical potential
volt-amp	VA	power
watt	W	power

*1 lumen = 0.001496 watt of monochromatic light at a wavelength of 546 nm

TABLE 2. Unit Prefixes

Decimal Equivalent	Prefix	Symbol	Exponential Expression
1 000 000 000 000	tera	T	10^{12}
1 000 000 000	giga	G	10^{9}
1 000 000	mega	M	10^{6}
1 000	kilo	k	10^{3}
100	hecto	h	10^{2}
10	deka	da	10
0.1	deci	d	10^{-1}
0.01	centi	c	10^{-2}
0.001	milli	m	10^{-3}
0.000 001	micro	µ	10^{-6}
0.000 000 001	nano	n	10^{-9}
0.000 000 000 001	pico	p	10^{-12}

TABLE 3. English-Metric Conversion

Inch Fraction	Inch Decimal	Millimeter	Inch Fraction	Inch Decimal	Millimeter	Inch Fraction	Inch Decimal	Millimeter
---	.0039	0.1	9/32	.2812	7.144	21/32	.6562	16.669
---	.0079	0.2	19/64	.2969	7.541	---	.6693	17
---	.0118	0.3	5/16	.3125	7.938	43/64	.6719	17.066
1/64	.0156	0.397	---	.3150	8	11/16	.6875	17.462
---	.0157	0.4	21/64	.3281	8.334	45/64	.7031	17.859
---	.0197	0.5	11/32	.3438	8.731	---	.7087	18
---	.0236	0.6	---	.3543	9	23/32	.7188	18.256
---	.0276	0.7	23/64	.3594	9.128	47/64	.7344	18.653
1/32	.0312	0.794	3/8	.375	9.525	---	.7480	19
---	.0315	0.8	25/64	.3906	9.922	3/4	.750	19.050
---	.0354	0.9	---	.3937	10	49/64	.7656	19.447
---	.0394	1	13/32	.4062	10.319	25/32	.7812	19.844
3/64	.0469	1.191	27/64	.4219	10.716	---	.7874	20
1/16	.0625	1.588	---	.4331	11	51/64	.7969	20.241
5/64	.0781	1.984	7/16	.4375	11.112	13/16	.8125	20.638
---	.0787	2	29/64	.4531	11.509	---	.8268	21
3/32	.0938	2.381	15/32	.4688	11.906	53/64	.8281	21.034
7/64	.1094	2.778	---	.4724	12	27/32	.8438	21.431
---	.1181	3	31/64	.4844	12.303	55/64	.8594	21.828
1/8	.1250	3.175	1/2	.500	12.700	---	.8661	22
9/64	.1406	3.572	---	.5118	13	7/8	.875	22.225
5/32	.1562	3.969	33/64	.5156	13.097	57/64	.8906	22.622
---	.1575	4	17/32	.5312	13.494	---	.9055	23
11/64	.1719	4.366	35/64	.5469	13.891	29/32	.9062	23.019
3/16	.1875	4.762	---	.5512	14	59/64	.9219	23.416
---	.1968	5	9/16	.5625	14.288	15/16	.9375	23.812
13/64	.2031	5.159	37/64	.5781	14.684	---	.9449	24
7/32	.2188	5.556	---	.5905	15	61/64	.9531	24.209
15/64	.2344	5.953	19/32	.5938	15.081	31/32	.9688	24.606
---	.2362	6	39/64	.6094	15.478	---	.9842	25
1/4	.2500	6.350	5/8	.625	15.875	63/64	.9844	25.003
17/64	.2656	6.747	---	.6299	16	1	1.000	25.400
---	.2756	7	41/64	.6406	16.272	---	---	---

To convert millimeters to inches, multiply by 0.0394.

To convert inches to millimeters, multiply by 25.4.

TABLE 4. Drill Sizes for Mounting Hardware

Thread Size	Tap Drill	Clearance Drill
#2-56	#50 (0.0700")	#42 (0.0935")
#4-40	#43 (0.0890")	#31 (0.1200")
#6-32	#36 (0.1065")	#25 (0.1495")
#6-40	#33 (0.1130")	#25 (0.1495")
#8-32	#29 (0.1360")	#16 (0.1770")
#10-24	#25 (0.1495")	#7 (0.2010")
#10-32	#21 (0.1590")	#7 (0.2010")
#1/4"-20	#7 (0.2010")	#H (0.2660")
#5.16"-24	#I (0.2720")	#Q (0.3320")
#3/8"-32	11/32 (0.3438")	25/64" (0.3906")
#7/16"-20	25/64" (0.3906")	15/32" (0.4687")
#1/2"-14 NPSM	23/32" (0.7188")	55/64" (0.8594")
#1/2"-32	15/32" (0.4688")	17/32"(0.5312")

Thread Size	Tap Drill	Clearance Drill
M2.5 x 0.45	2.05mm (0.0807") or #46 (0.0810")	2.9mm (0.1142") or #32 (0.1160")
M3 x 0.5	2.50mm (0.0984") or #39 (0.0995")	3.4mm (0.1339") or #29 (0.1360")
M4 x 0.7	3.30mm (0.1299") or #29 (0.1360")	4.5mm (0.1772") #15 (0.1800")
M6 x 0.75	5.00mm (0.1969") or #8 (0.1990")	6.6mm (0.2598") or #G (0.2610")
M18 x 1	15.5mm (0.6102") or 39/64" (0.6094")	20.0mm (0.7874") or 51/64" (0.7969")
M30 x 1.5	26.5 mm (1.0433") or 1-3/64" (1.0469")	33.0mm (1.2992") or 1-5/16" (1.3125")

TABLE 5. Velocity Conversion

1		2		3		4	
Feet/minute	Meters/ minute	Inches/ minute	Millimeters/ minute	Inches/ second	Millimeters/ second	Seconds/ inch	Seconds/ millimeter
.5	.152	6	152.4	.10	2.540	10.0	.394
1	.305	12	304.8	.20	5.080	5.0	.197
2	.610	24	609.6	.40	10.16	2.50	.098
3	.914	36	914.4	.60	15.24	1.67	.0656
4	1.22	48	1219.2	.80	20.32	1.25	.0492
5	1.52	60	1524.0	1.0	25.40	1.00	.0394
6	1.83	72	1828.8	1.2	30.48	.833	.0328
7	2.13	84	2133.6	1.4	35.56	.714	.0281
8	2.44	96	2438.4	1.6	40.64	.625	.0246
9	2.74	108	2743.2	1.8	45.72	.555	.0219
10	3.05	120	3048.0	2.0	50.8	.500	.0197
11	3.35	132	3352.8	2.2	55.88	.455	.0179
12	3.66	144	3657.6	2.4	60.96	.417	.0164
13	3.96	156	3962.4	2.6	66.04	.385	.0151
14	4.27	168	4267.2	2.8	71.12	.357	.0141
15	4.57	180	4572.0	3.0	76.20	.333	.0131
16	4.88	192	4876.8	3.2	81.28	.313	.0123
17	5.18	204	5181.6	3.4	86.36	.294	.0116
18	5.49	216	5486.4	3.6	91.44	.278	.0109
19	5.79	228	5791.2	3.8	96.52	.263	.0104
20	6.10	240	6096.0	4.0	101.6	.250	.00984
21	6.40	252	6400.8	4.2	106.7	.238	.00937
22	6.71	264	6705.6	4.4	111.8	.227	.00895
23	7.01	276	7010.4	4.6	116.8	.217	.00856
24	7.31	288	7315.2	4.8	121.9	.208	.00820
25	7.62	300	7620.0	5.0	127.0	.200	.00787
30	9.14	360	9144.0	6.0	152.4	.167	.00656
40	12.19	480	12192	8.0	203.2	.125	.00492
50	15.24	600	15240	10	254.0	.100	.00394
60	18.29	720	18288	12	304.8	.083	.00328
70	21.34	840	21336	14	355.6	.071	.00281
80	24.38	960	24384	16	406.4	.063	.00246
90	27.43	1080	27432	18	457.2	.056	.00219
100	30.48	1200	30480	20	508.0	.050	.00197
125	38.10	1500	38100	25	635.0	.040	.00157
150	45.72	1800	45720	30	762.0	.033	.00131
175	53.34	2100	53340	35	889.0	.029	.00112
200	60.96	2400	60960	40	1016	.025	.00098
225	68.58	2700	68580	45	1143	.022	.00087
250	76.20	3000	76200	50	1270	.020	.00079
275	83.82	3300	83820	55	1397	.018	.00072
300	91.44	3600	91440	60	1524	.016	.00066
325	99.06	3900	99060	65	1651	.015	.00061
350	106.7	4200	106680	70	1778	.014	.00056
375	114.3	4500	114300	75	1905	.013	.00052
400	121.9	4800	121920	80	2032	.012	.00049
450	137.2	5400	137160	90	2286	.011	.00044
500	152.4	6000	152400	100	2540	.010	.00039
600	182.9	7200	182880	120	3048	.0083	.00033
700	213.4	8400	213360	140	3556	.0071	.00028
800	243.8	9600	243840	160	4064	.0063	.00025
900	274.3	10800	274320	180	4572	.0055	.00022
1000	304.8	12000	304800	200	5080	.0050	.000197
1250	381.0	15000	381000	250	6350	.0040	.000157
1665	507.5	19980	507492	333	8458	.0030	.000118
2500	762.0	30000	762000	500	12700	.0020	.000079
5000	1524	60000	1524000	1000	25400	.0010	.000039

TABLE 6. Velocity Conversion Factors

From: \ To:	Miles/ hour	Feet/ minute	Inches/ minute	Meters/ minute	Centimeters/ minute	Feet/ second	Inches/ second	Meters/ second	Millimeters/ second
1 mile/ hour	1.0	88	1056	26.822	2682.24	1.4667	17.60	0.4470	447.0
1 foot/ minute	1.1364×10^{-2}	1.0	12.0	0.3048	30.48	1.6667×10^{-2}	20.000	5.08×10^{-3}	5.08
1 inch/ minute	9.470×10^{-4}	8.333×10^{-2}	1.0	2.540×10^{-2}	2.54	1.3888×10^{-3}	1.6666×10^{-2}	4.23×10^{-4}	0.0423
1 meter/ minute	3.7282×10^{-2}	3.281	39.372	1.0	100.0	5.468×10^{-2}	0.6562	1.667×10^{-2}	16.667
1 centi-meter/ minute	3.7282×10^{-4}	3.281×10^{-2}	0.3937	0.01	1.0	5.468×10^{-4}	6.5616×10^{-3}	1.667×10^{-4}	0.1667
1 foot/ second	0.6818	60	720	18.29	1829	1.0	12	0.3048	304.8
1 inch/ second	5.6818×10^{-2}	5	60	1.524	152.4	8.333×10^{-2}	1.0	2.540×10^{-2}	25.40
1 meter/ second	2.2369	196.85	2362.2	60.0	6000.0	3.281	39.372	1.0	1000
1 milli-meter/ second	2.2369×10^{-3}	0.1969	2.3622	6.0×10^{-2}	6.000	3.281×10^{-3}	3.937×10^{-2}	1×10^{-3}	1.0

TABLE 7. Length Conversion Factors

From: \ To:	Angstroms	Milli-meters	Centi-meters	Inches	Feet	Yards	Meters	Kilo-meters	Miles (imperial)
1 Angstrom (Å)	1.0	1.0×10^{-7}	1.0×10^{-8}	3.937×10^{-9}	3.2808×10^{-10}	1.0936×10^{-10}	1.0×10^{-10}	1.0×10^{-13}	6.2137×10^{-14}
1 millimeter (mm)	1.0×10^{7}	1.0	0.1	0.0394	3.2808×10^{-3}	1.0936×10^{-3}	1.0×10^{-3}	1.0×10^{-6}	6.2137×10^{-7}
1 centimeter (cm)	1.0×10^{8}	10.0	1.0	0.3937	0.0328	0.0109	0.01	1.0×10^{-5}	6.2137×10^{-6}
1 inch (in)	2.54×10^{8}	25.4	2.54	1.0	0.0833	0.0278	0.0254	2.54×10^{-5}	1.5783×10^{-5}
1 foot (ft)	3.048×10^{9}	304.8	30.48	12.0	1.0	0.3333	0.3048	3.048×10^{-4}	1.8939×10^{-4}
1 yard (yd)	9.144×10^{9}	914.4	91.44	36.0	3.0	1.0	0.9144	9.144×10^{-4}	5.6818×10^{-4}
1 meter (m)	1.0×10^{10}	1.0×10^{3}	100.0	39.3701	3.2808	1.0936	1.0	1.0×10^{-3}	6.2137×10^{-4}
1 kilometer (km)	1.0×10^{13}	1.0×10^{6}	1.0×10^{5}	3.937×10^{4}	3.2808×10^{3}	1.0936×10^{3}	1.0×10^{3}	1.0	0.6214
1 mile (imperial)	1.6093×10^{13}	1.6093×10^{6}	1.6093×10^{5}	6.336×10^{4}	5.280×10^{3}	1.760×10^{3}	1.6093×10^{3}	1.6093	1.0

TABLE 8. Temperature Conversion: °C ⟷ °F

Celsius°	Fahrenheit°	Celsius°	Fahrenheit°	Celsius°	Fahrenheit°
-62	-80	0.0	32	22.2	72
-57	-70	0.6	33	22.8	73
-51	-60	1.1	34	23.3	74
-46	-50	1.7	35	23.9	75
-40	-40	2.2	36	24.4	76
-34	-30	2.8	37	25.0	77
-29	-20	3.3	38	25.6	78
-23	-10	3.9	39	26.1	79
-17.8	0	4.4	40	26.7	80
-17.2	1	5.0	41	27.2	81
-16.7	2	5.6	42	27.8	82
-16.1	3	6.1	43	28.3	83
-15.6	4	6.7	44	28.9	84
-15.0	5	7.2	45	29.4	85
-14.4	6	7.8	46	30.0	86
-13.9	7	8.3	47	30.6	87
-13.3	8	8.9	48	31.1	88
-12.8	9	9.4	49	31.7	89
-12.2	10	10.0	50	32.2	90
-11.7	11	10.6	51	32.8	91
-11.1	12	11.1	52	33.3	92
-10.6	13	11.7	53	33.9	93
-10.0	14	12.2	54	34.4	94
-9.4	15	12.8	55	35.0	95
-8.9	16	13.3	56	35.6	96
-8.3	17	13.9	57	36.1	97
-7.8	18	14.4	58	36.7	98
-7.2	19	15.0	59	37.2	99
-6.7	20	15.6	60	37.8	100
-6.1	21	16.1	61	43	110
-5.6	22	16.7	62	49	120
-5.0	23	17.2	63	54	130
-4.4	24	17.8	64	60	140
-3.9	25	18.3	65	66	150
-3.3	26	18.9	66	71	160
-2.8	27	19.4	67	77	170
-2.2	28	20.0	68	82	180
-1.7	29	20.6	69	88	190
-1.1	30	21.1	70	93	200
-0.6	31	21.7	71	100	212

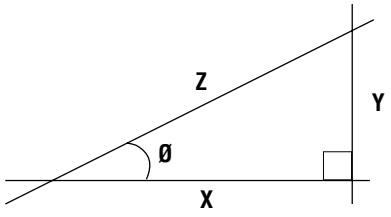
NOTE: For temperatures not given in the table, use the conversion information at the right.

Temperature Scale	Water Boiling Point	Water Freezing Point	To Convert Scales:
°F (Fahrenheit)	212°F	32°F	°F = (°C x $^{9}/_{5}$) + 32
°C (Celsius or Centigrade)	100°F	0°C	°C = (°F - 32) x $^{5}/_{9}$

TABLE 9. Trigonometric Functions and Formulas

Degrees	sin	cos	tan	cot	sec	csc	
0	0.0000	1.0000	0.0000	–	1.0000	–	90
1	0.0174	0.9998	0.0175	57.290	1.0002	57.299	89
2	0.0349	0.9994	0.0349	28.636	1.0006	28.654	88
3	0.0523	0.9986	0.0524	19.081	1.0014	19.107	87
4	0.0698	0.9976	0.0699	14.301	1.0024	14.336	86
5	0.0872	0.9962	0.0875	11.430	1.0038	11.474	85
6	0.1045	0.9945	0.1051	9.5144	1.0055	9.5668	84
7	0.1219	0.9925	0.1228	8.1443	1.0075	8.2055	83
8	0.1392	0.9903	0.1405	7.1154	1.0098	7.1853	82
9	0.1564	0.9877	0.1584	6.3138	1.0125	6.3924	81
10	0.1736	0.9848	0.1763	5.6713	1.0154	5.7588	80
11	0.1908	0.9816	0.1944	5.1446	1.0187	5.2408	79
12	0.2079	0.9781	0.2126	4.7046	1.0223	4.8097	78
13	0.2250	0.9744	0.2309	4.3315	1.0263	4.4454	77
14	0.2419	0.9703	0.2493	4.0108	1.0306	4.1336	76
15	0.2588	0.9659	0.2679	3.7320	1.0353	3.8637	75
16	0.2756	0.9613	0.2867	3.4874	1.0403	3.6280	74
17	0.2924	0.9563	0.3057	3.2708	1.0457	3.4203	73
18	0.3090	0.9511	0.3249	3.0777	1.0515	3.2361	72
19	0.3256	0.9455	0.3443	2.9042	1.0576	3.0715	71
20	0.3420	0.9397	0.3640	2.7475	1.0642	2.9238	70
21	0.3584	0.9336	0.3839	2.6051	1.0711	2.7904	69
22	0.3746	0.9272	0.4040	2.4751	1.0785	2.6695	68
23	0.3907	0.9205	0.4245	2.3558	1.0864	2.5593	67
24	0.4067	0.9135	0.4452	2.2460	1.0946	2.4586	66
25	0.4226	0.9063	0.4663	2.1445	1.1034	2.3662	65
26	0.4384	0.8988	0.4877	2.0503	1.1126	2.2812	64
27	0.4540	0.8910	0.5095	1.9626	1.1223	2.2027	63
28	0.4695	0.8829	0.5317	1.8807	1.1326	2.1300	62
29	0.4848	0.8746	0.5543	1.8040	1.1434	2.0627	61
30	0.5000	0.8660	0.5774	1.7320	1.1547	2.0000	60
31	0.5150	0.8572	0.6009	1.6643	1.1666	1.9416	59
32	0.5299	0.8580	0.6249	1.6003	1.1792	1.8871	58
33	0.5446	0.8387	0.6494	1.5399	1.1924	1.8361	57
34	0.5592	0.8290	0.6745	1.4826	1.2062	1.7883	56
35	0.5736	0.8192	0.7002	1.4281	1.2208	1.7434	55
36	0.5878	0.8090	0.7265	1.3764	1.2361	1.7013	54
37	0.6018	0.7986	0.7536	1.3270	1.2521	1.6616	53
38	0.6157	0.7880	0.7813	1.2799	1.2690	1.6243	52
39	0.6293	0.7771	0.8098	1.2349	1.2868	1.5890	51
40	0.6428	0.7660	0.8391	1.1918	1.3054	1.5557	50
41	0.6561	0.7547	0.8693	1.1504	1.3250	1.5242	49
42	0.6691	0.7431	0.9004	1.1106	1.3456	1.4945	48
43	0.6820	0.7314	0.9325	1.0724	1.3673	1.4663	47
44	0.6947	0.7193	0.9567	1.0355	1.3902	1.4396	46
45	0.7071	0.7071	1.0000	1.0000	1.4142	1.4142	45
Degrees	**cos**	**sin**	**cot**	**tan**	**csc**	**sec**	**Degrees**

Trigonometric Formulas for Distance or Angle Calculation



Relationships:

sin ø = Y/Z
cos ø = X/Z
tan ø = X/Y
csc ø = Z/Y = 1/sin ø
sec ø = Z/X = 1/cos ø
cot ø = X/Y = 1/tan ø

Given ø and X:	Y = X tan ø	Z = X sec ø
Given ø and Y:	X = Y cot ø	Z = Y csc ø

Given ø and Z:	$X = Z \cos ø$	Y = Z sin ø
Given X and Y:	$Z = \sqrt{X^2 + Y^2}$	ø = arctan (Y/X)

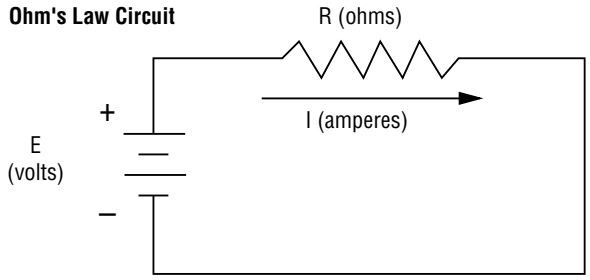
Basic Electrical Formulas

Ohm's Law describes the relationship between voltage, resistance, and current in electrical circuits. As stated by Ohm's Law, the current in the figure below is directly proportional to the applied voltage and inversely proportional to the resistance of the circuit. This relationship, in the form of an equation, is written as follows:

$$I = \frac{E}{R}$$

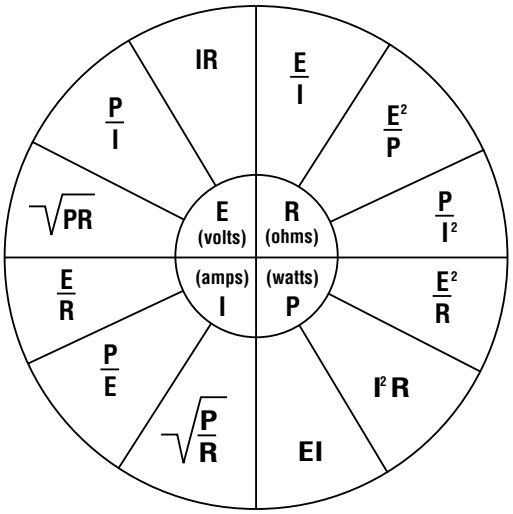
where **I** is the current (in amperes), **E** is the electromotive force (in volts), and **R** is the resistance (in ohms). It follows that:

$$E = I \times R \quad \text{and} \quad R = \frac{E}{I}$$



As an example, if R=100 ohms and E=10 volts, then the current in the circuit is equal to:

$$I = \frac{10}{100}$$ or $^1/_{10}$ amp, or 100 milliamps



Electrical power may also be quantified in terms of a single equation. Power is the rate of doing work, and is measured in units called *watts*. Watts are equal to *voltage x current. DC power equations* relate power (in watts), current (in amperes), and resistance (in ohms), as follows:

$$P = E \times I \qquad P = \frac{E^2}{R} \qquad P = I^2 \times R$$

As an example, if R = 1000 ohms and E = 10 volts, the power used in the circuit is:

$$P = \frac{E^2}{R} = \frac{100}{1000} = {}^1/_{10} \text{ watt} = 100 \text{ milliwatts}$$

TABLE 10. Resistor Color Codes

Color	Digit	Multiplier	Tolerance
black	0	1	±1%
brown	1	10	±2%
red	2	100	±3 %
orange	3	1000	±4%
yellow	4	10000	
green	5	100000	
blue	6	1000000	
violet	7	10000000	
gray	8	100000000	
white	9		
gold		0.1	±5%
silver		0.01	±10%
no color			±20%

The colored bands on the bodies of resistors denote their *value* (in ohms), and their *tolerance* (in ±%). With the resistor positioned as shown below, the first two color bands are digits ,the next is the multiplier, and the next (if present) is the tolerance.

As an example ,a resistor color-coded YELLOW-VIOLET-BROWN-GOLD would be 47 x 10, ±5% tolerance or: 470 ohms (±5% tolerance).

Precision resistors usually have their values stamped on the resistor body. Some film-type resistors may have three significant figures and, therefore, use five color bands (including *3* digit bands and 1 multiplier band).

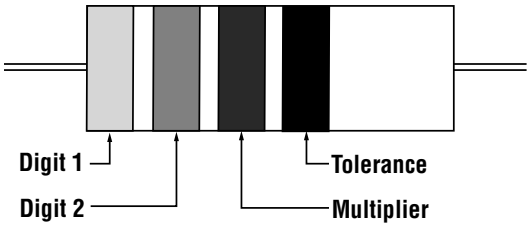


TABLE 11. Copper Wire Information

AWG	Solid Wire Diameter American Wire or Brown and Sharpe Gage		Approximate Stranded Wire Diameter[1]		Approximate Resistance per 100 feet (30 meters)[2]
	Inches	Millimeters	Inches	Millimeters	Ohms
0000	.4601	11,687	.522	13.26	.0050
000	.4097	10.406	.464	11.79	.0060
00	.3648	9.266	.414	10.52	.0080
0	.3249	8.252	.368	9.35	.010
1	.2893	7.348	.328	8.33	.012
2	.2576	6.543	.292	7.42	.016
3	.2294	5.827			.020
4	.2043	5.189	.232	5.89	.025
5	.1819	4.620			.030
6	.1620	4.115	.184	4.67	.040
7	.1443	3.665			.050
8	.1285	3.264	.147	3.73	.060
9	.1144	2.906			.080
10	.1019	2.588	.116	2.95	.10
11	.0907	2.304			.13
12	.0808	2.052	.095	2.41	.16
13	.0720	1.829			.20
14	.0641	1.628	.073	1.85	.25
15	.0571	1.450			.32
16	.0508	1.290	.059	1.50	.40
17	.0453	1.151			.50
18	.0403	1.024	.048	1.22	.64
19	.0359	0.912			.80
20	.0320	0.813	.036	0.91	1.0
21	.0285	0.724			1.3
22	.0253	0.643	.030	0.76	1.6
23	.0226	0.574			2.0
24	.0201	0.511	.024	0.61	2.6
25	.0179	0.455			3.2
26	.0159	0.404	.020	0.51	4.1
27	.0142	0.361	.018	0.46	5.2
28	.0126	0.320	.015	0.38	6.5
29	.0113	0.287			8.2
30	.0100	0.254	.012	0.30	10
31	.00892	0.227			13
32	.00795	0.202	.008	0.20	16
33	.00708	0.180			20
34	.00630	0.160	.007	0.18	26
35	.00561	0.142			33
36	.00500	0.127	.006	0.15	42
37	.00445	0.113			52
38	.00396	0.101			66
39	.00353	0.090			83
40	.00314	0.080			105
41	.00280	0.071			130
42	.00249	0.063			170
43	.00222	0.056			210
44	.00198	0.050			270
45	.00176	0.045			330
46	.00157	0.040			420

[1] Exact diameter is dependent upon the wire gage used for the strands. Diameter listed represents the most common wire type for AWG.

[2] Resistance values assume the resistivity of solid copper wire. Stranding and/or copper alloy increase the resistance values.

TABLE 12. Hazardous Location Classifications per National Electrical Code (NEC) Article 500

CLASS	DIVISION	GROUP
CLASS I Locations in which flammable gases or vapors are (or may be) present in the air in quantities great enough to produce explosive or ignitable mixtures.	**DIVISION 1:** Locations in which hazardous concentrations of flammable gases or vapors exist continuously, intermittently, or periodically under normal conditions. -or- Locations in which hazardous concentrations of flammable gases or vapors may exist frequently because of repair or maintenance operations or because of leakage. -or- Locations in which breakdown or faulty operation of equipment or processes might release hazardous concentrations of flammable gases or vapors. **DIVISION 2:** Locations in which volatile flammable liquids or flammable gases are handled, processed, or used, but are normally kept in closed containers and can only escape due to accidental rupture. -or- Locations in which hazardous concentrations of gases or vapors are normally prevented by mechanical ventilation and might become hazardous due to failure of the ventilating equipment. -or- Locations that are adjacent to Class I, Division 1 locations.	**GROUP A:** Atmospheres containing acetylene **GROUP B:** Atmospheres containing: acrolein (inhibited) butadiene ethylene oxide hydrogen manufactured gases containing more than 30% hydrogen by volume propylene oxide **GROUP C:** Atmospheres containing: allyl alcohol carbon monoxide cyclopropane diethyl ether ethylene hydrogen sulfide methyl ether n-propyl ether or gas or vapors of equivalent hazard **GROUP D:** Atmospheres containing: acetone ammonia benzene butane butyl alcohol ethane ethyl alcohol gasoline heptanes hexanes methane (natural gas) methyl alcohol methyl ethyl ketone (MEK) naphtha octanes pentanes propane styrene toluene xylenes or gas or vapors of equivalent hazard
CLASS II Locations in which there are explosive mixtures of air and combustible dust.	**DIVISION 1:** Locations in which explosive or ignitible amounts of combustible dust is or may be in suspension in the air continuously, intermittently, or periodically under normal operating conditions. -or- Locations where mechanical failure or abnormal operation of machinery or equipment might cause explosive or ignitable mixtures to be produced. -or- Locations in which combustible electrically conductive dust is present. **DIVISION 2:** Locations where combustible dust deposits exist but are not likely to be thrown into suspension in the air, but where the dust deposits may be heavy enough to interfere with safe heat dissipation from electric equipment. -or- Locations where combustible dust deposits may be ignited by arcs, sparks, or burning material from electric equipment.	**GROUP E:** Atmospheres containing combustible: metal dusts regardless of resistivity -or- dusts of similarly hazardous characteristics having resistivity of less than 100,000 ohm-centimeter **GROUP F:** atmospheres containing combustible: carbon black, charcoal, or coke dusts which have more than 8% total volatile material -or- carbon black, charcoal, or coke dusts sensitized by other materials so that they present an explosion hazard, and having a resistivity greater than 100 ohm-centimeter but equal to or less than 100,000,000 ohm-centimeter **GROUP G:** Atmospheres containing dusts having resistivity of 100,000,000 ohm-centimeter or greater (nonconductive dusts)
CLASS III Locations in which there is the presence of easily-ignited fibers or flyings, but where the fibers or flyings are not likely to be in suspension in the air in quantities great enough to produce ignitable mixtures.	**DIVISION 1:** Locations in which easily ignitable fibers or materials producing flyings are handled, manufactured, or used. **DIVISION 2:** Locations in which easily ignitable fibers are stored or handled (except in a manufacturing process).	(NOT GROUPED) Manufacturers include: textile mills, clothing plants, fiber processing plants Easily ignitable fibers include: cotton, rayon, sisal, hemp, jute

TABLE 13. NEMA Enclosure Ratings for Nonhazardous Locations

Standard NEMA (IEC)*	Intended Use	Accidental bodily contact	Falling dirt	Dust, lint, fibers (non-volatile)	Windblown dust	Falling liquid, light splash	Hosedown and heavy splash	Rain, snow, and sleet	Ice buildup	Oil or coolant seepage	Oil or coolant spray and splash	Occasional submersion	Prolonged sub-mersion	Corrosive agents
NEMA 1 (IP10)	Indoor	Yes	Yes	...	...	...	...	...	...	...	...	...	...	...
NEMA 2 (IP11)	Indoor	Yes	Yes	...	...	Yes	...	...	...	...	...	...	...	...
NEMA 3 (IP54)	Outdoor	Yes	Yes	Yes	Yes	Yes	...	Yes	...	...	...	...	...	...
NEMA 3S (IP54)	Outdoor	Yes	Yes	Yes	Yes	Yes	...	Yes	Yes	...	...	...	...	...
NEMA 4 (IP56)	Indoor or Outdoor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	...	...
NEMA 4X (IP56)	Indoor or Outdoor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	...	...	Yes
NEMA 6 (IP67)	Indoor or Outdoor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	Yes	...	...
NEMA 6P (IP67)	Indoor or Outdoor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	...	...	...	Yes	Yes	Yes
NEMA 12 (IP52)	Indoor	Yes	Yes	Yes	...	Yes	...	...	...	Yes	...	...	...	...
NEMA 13 (IP54)	Indoor	Yes	Yes	Yes	...	Yes	...	...	...	Yes	Yes	...	...	...

*The IEC equivalents listed in this column are approximate: NEMA types *meet or exceed* the test requirements for the associated IEC classifications.

TABLE 14. IP Enclosure Ratings for Nonhazardous Locations

1ST CHARACTERISTIC: Protection against contact and penetration of solid bodies	
Numeral	**Short Description**
0	Non-protected
1	Protected against solid objects greater than 50 mm
2	Protected against solid objects greater than 12 mm
3	Protected against solid objects greater than 2.5 mm
4	Protected against solid objects greater than 1.0 mm
5	Dust protected
6	Dust-tight
2ND CHARACTERISTIC: Protection against the penetration of liquids	
Numeral	**Short Description**
0	Non-protected
1	Protected against dripping water
2	Protected against dripping water when tilted up to 15°
3	Protected against spraying water
4	Protected against splashing water
5	Protected against water jets
6	Protected against heavy seas
7	Protected against the effects of immersion
8	Protected against submersion

TABLE 15. Relative Chemical Resistance of Sensor Housing Materials and Lenses

Housing Material	RESISTANCE TO: Industrial Solvents	Dilute Acids	Concentrated Acids	Dilute Caustic Alkalis	Concentrated Caustic Alkalis	10% Sodium Hydroxide in Steam	Sunlight and Weathering
Thermoplastic Polyester	**FAIR** Attacked by: acetone, MEK, and methylene chloride	EXCELLENT	GOOD	POOR	POOR	POOR	GOOD
Lexan® Polycarbonate	**POOR** Attacked by: acetone, MEK, and methylene chloride	GOOD	FAIR	POOR	POOR	POOR	GOOD
NORYL® Polyphenylene oxide (PPO)	**FAIR** Attacked by: chlorinated hydrocarbons[1]	GOOD	FAIR	EXCELLENT	GOOD	GOOD	EXCELLENT
Delrin® Acetal	GOOD	FAIR	POOR	FAIR	POOR	FAIR	GOOD
Epoxy-coated zinc-aluminumalloy	GOOD	GOOD	FAIR	GOOD	FAIR	FAIR	EXCELLENT
Anodized aluminum	EXCELLENT	FAIR	POOR	GOOD	FAIR	FAIR	GOOD
Stainless steel	EXCELLENT	FAIR	POOR	EXCELLENT	GOOD	GOOD	GOOD
PVC (Polyvinyl- chloride)	**FAIR** Attacked by: acetone, MEK, and methylene chloride	GOOD	FAIR	EXCELLENT	EXCELLENT	EXCELLENT	GOOD
Polyethylene	**FAIR** Attacked by: chlorinated hydrocarbons[1]	EXCELLENT	EXCELLENT	GOOD	GOOD	GOOD	POOR
Cycolac® ABS	**POOR** Attacked by: acetone, MEK, esters, ketones, & some chlorinated hydrocarbons	GOOD	POOR	GOOD	GOOD	GOOD	FAIR
Lens Material	**Industrial Solvents**	**Dilute Acids**	**Concentrated Acids**	**Dilute Caustic Alkalis**	**Concentrated Caustic Alkalis**	**10% Sodium Hydroxide in Steam**	**Sunlight and Weathering**
Glass[2]	EXCELLENT	GOOD	FAIR	EXCELLENT	GOOD	GOOD	EXCELLENT
Acrylic[3]	POOR	FAIR	POOR	GOOD	FAIR	FAIR	GOOD
Polysulfone	**FAIR** Attacked by: chlorinated hydrocarbons[3]	FAIR	POOR	FAIR	POOR	POOR	POOR
Lexan® Polycarbonate	**POOR** (see **Lexan®**, above)	GOOD	FAIR	POOR	POOR	POOR	GOOD

Key to Performance

Rating	Percent Retention to Strength	Degree of Attack
Excellent	85 to 100%	Slight (or no) attack
Good	75 to 84%	Moderate attack
Fair	50 to 74%	Noticeable swelling, softening, etching, or corrosion
Poor	<50%	Severe degradation

NOTES:

NOTE 1: Chlorinated hydrocarbons include Freon, methylene chloride, trichlorethane, and trichloroethylene.

NOTE 2: Plastic lens covers are available for some sensors to meet FDA requirements.

NOTE 3: Glass covers are available for some sensors to protect the acrylic lens.

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Delrin® is a registered trademark of Dupont Co.

Optical Safety Systems

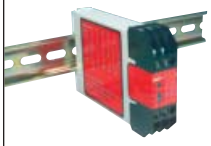
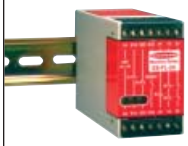
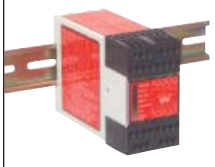
	Product	**EZ-GUARD™**		**MICRO-SCREEN®**			
	www.bannerengineering.com/sg	/ezguard		/microscreen			
Emitters and Receivers	**Type**	Point	Grid	Standard		V-Series	
	Description	Single Beam	Two Beam Three Beam Four Beam	Screen		Screen	
	Detection Capability	Torso, Body	Torso, Body	Finger, Hand, Ankle		Hand, Ankle	
	Minimum Object Detection Size	N/A	N/A	19 mm (0.75")		32 mm (1.25")	
	Emitter/Receiver Range	0.8 m to 20 m (2.6' to 65') 15 m to 70 m (49' to 230')	0.8 m to 20 m (2.6' to 65') 15 m to 70 m (49' to 230')	9 m (30')		9 m (30') 6 m (20')	
	Protective Heights	N/A	2 beams – 500 mm (19.7") total 3 beams – 800 mm (31.5") total 4 beams – 900 mm (35.4") total 2 beams – 584 mm (23") total 3 beams – 1066 mm (42") total	102 to 1219 mm (4" to 48")		610 to 1219 mm (24" to 48") 1422 to 1829 mm (56" to 72")	
Controllers	**Controller Housing**	In Receiver	In Receiver	Metal box	DIN	Metal box	DIN
	Available Control Functions	Selectable Trip or Latch	Selectable Trip or Latch	Trip, Blanking, Mute, EDM	Trip, Latch, DeviceNet™, EDM, Blanking	Trip, Blanking, Mute, EDM	Trip, Latch, DeviceNet™, EDM, Blanking
	Supply Voltage	24V dc	24V dc	115V ac, 230V ac, or 24V dc	24V dc	115V ac, 230V ac, or 24V dc	24V dc

Optical Safety Systems

	Product	MINI-SCREEN®				MACHINE- and PERIMETER-GUARD™		
	www.bannerengineering.com/sg	/miniscreen				/machineguard		
Emitters and Receivers	**Type**	Standard		Long-Range		Machine-Guard		Perimeter-Guard
	Description	Screen		Screen		Screen		Screen
	Detection Capability	Finger, Hand, Ankle		Hand, Ankle		Hand, Ankle		Hand, Ankle
	Minimum Object Detection Size	19 mm (.75")		25 mm (1")		38 mm (1.5")		38 mm (1.5")
	Emitter/Receiver Range	9 m (30')		18 m (60')		14 m (45')		14 m (45')
	Protective Heights	114 to 1219 mm (4.5" to 48")		114 to 1219 mm (4.5" to 48")		152 to 1829 mm (6" to 72")		152 to 1829 mm (6" to 72")
Controllers	**Controller Housing**	Metal box	DIN	Metal box	DIN	Metal box		Metal box
	Available Control Functions	Trip, Latch, EDM, Dual Trip, Mute, Blanking	Trip, Latch, EDM, Dual Trip, Dual Latch, Blanking	Trip, Latch, EDM, Dual Trip, Mute, Blanking	Trip, Latch, EDM, Dual Trip, Dual Latch, Blanking	Trip, Blanking	Dual Trip	Latch Blanking
	Supply Voltage	115V ac, 230V ac, or 24V dc	24V dc	115V ac, 230V ac, or 24V dc	24V dc	115V ac or 230V ac	115V ac, 230V ac, or 24V dc	115V ac or 230V ac

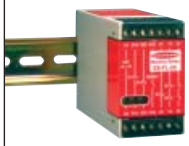
Emergency Stop Safety Modules Selection Chart

www.bannerengineering.com/sg/safetymodules

	Models	Stop Category	Supply Voltage	Inputs	Safety Outputs	Aux. Outputs	Delay Options	Housing Width	Terminals	Certifications
	**ES-FA-6G**	0	24V ac/dc	1 Single Channel	3 @ 6 amps	1 N.C.	N/A	22.5 mm	Fixed	CE, CSA, UL Emergency Stop Devices LISTED
	**ES-FA-9AA**	0	24V ac/dc	1 Dual Channel	3 @ 6 amps	N/A	N/A	22.5 mm	Removable	CE, CSA, UL Emergency Stop Devices LISTED
	**ES-FL-2A**	0	24V ac/dc	1 Dual Channel	2 @ 4 amps	1 N.C.	N/A	45 mm	Fixed	CE, CSA, UL Emergency Stop Devices LISTED
	**ES-..A-5A**	0	115V ac & 24V dc; 230V ac & 24V dc	1 Dual Channel	4 @ 5 amps	1 N.C. & 2 Solid-state	N/A	45 mm	Removable	CE, CSA, UL Emergency Stop Devices LISTED
	**ES-TN-1H..**	0 & 1	24V dc	1 Dual or 1 Single (select-able) Channel	2 delayed @ 4 amps; 2 immediate @ 4 amps	1 N.C. delayed & 1 N.C. imme-diate	0-20 sec or 0-200 sec adjustable (.5, 1, 2, 4, 6, 8, 10, 15, 20 sec fixed options avail-able)	45 mm	Removable	Approvals in process.
	**ES-TA-3..1***	0	24V dc	6 or 10 Dual Channels	2 @ 4 amps	N/A	N/A	107 mm or 149 mm	Removable	CE, CSA, UL Emergency Stop Devices LISTED

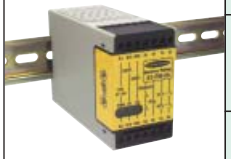
Safety Gate Monitoring Modules Selection Chart

www.bannerengineering.com/sg/safetymodules

	Models	Interlock Type	Supply Voltage	Inputs	Safety Outputs	Aux. Outputs	Delay Options	Housing Width	Terminals	Certifications
	**GM-FA-10J**	Mechanical & Magnetic	24V ac/dc	1 or 2 Dual Channel	2 @ 6 amps	N/A	N/A	22.5 mm	Removable	Approvals in process.
	**ES-FA-9AA**	Mechanical	24V ac/dc	1 Dual Channel	3 @ 6 amps	N/A	N/A	22.5 mm	Removable	CE, CSA, UL Emergency Stop Devices LISTED
	**ES-FL-2A**	Mechanical	24V ac/dc	1 Dual Channel	2 @ 4 amps	1 N.C. Reed	N/A	45 mm	Fixed	CE, CSA, UL Emergency Stop Devices LISTED
	**ES-..A-5A**	Mechanical	115V ac & 24V dc; 230V ac & 24V dc	1 Dual Channel	4 @ 5 amps	1 N.C. Reed & 2 Solid-state	N/A	45 mm	Removable	CE, CSA, UL Emergency Stop Devices LISTED
	**SI-MAG1C**	Magnetic	24V dc	1 Dual Channel	1 @ 4 amps	1 N.C. Reed	N/A	22.5 mm	Fixed	Approvals in process.
	**ES-TN-1H..**	Mechanical	24V dc	1 Dual or 1 Single (select-able) Channel	2 delayed @ 4 amps; 2 immediate @ 4 amps	1 N.C. delayed & 1 N.C. imme-diate	0-20 sec or 0-200 sec adjustable (.5, 1, 2, 4, 6, 8, 10, 15, 20 sec fixed options available)	45 mm	Removable	Approvals in process.

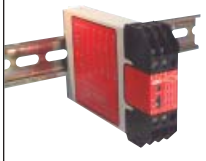
Two-Hand-Control Modules Selection Chart

www.bannerengineering.com/sg/safetymodules

	Models	Type	Supply Voltage	Input Type	Touch Button Type	Safety Outputs	Aux. Outputs	Housing Width	Terminals	Certifications
	**AT-FM-10K**	III C	24V ac/dc	Two Dual N.O./ N.C	STB	2 @ 6 amps	–	22.5 mm	Removable	Approvals in process.
	**AT-AM-2A**	III B	115V ac	Two N.O.	OTB	2 @ 4 amps	1 N.C. Reed	45 mm	Fixed	CE, UL Presence Sensing Device LISTED, c UL LISTED, TÜV Product Service Safety In Electronics
	AT-BM-2A	III B	230V ac	Two N.O.	OTB	2 @ 4 amps	1 N.C. Reed	45 mm	Fixed	
	AT-FM-2A	III B	24V ac/dc	Two N.O.	OTB	2 @ 4 amps	1 N.C. Reed	45 mm	Fixed	

Safety Extension Modules Selection Chart

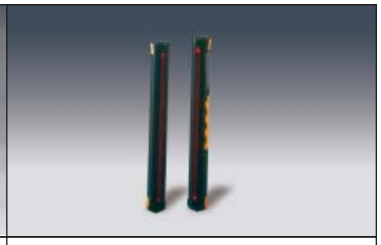
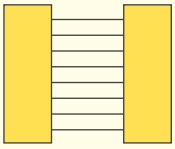
www.bannerengineering.com/sg/safetymodules

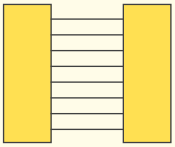
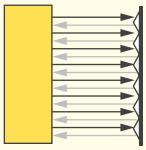
	Models	Supply Voltage	Input Type	Safety Outputs	Output Response /Delay	Housing Width	Terminals	Certifications
	**EM-T-7A**	24V dc	1 Dual or 1 Single Channel	4 @ 6 amps	20 ms	22.5 mm	Removable	CE, UL Emergency Stop Devices LISTED, c UL LISTED
	**EM-F-7G**	24V ac/dc	1 Single Channel	4 @ 6 amps	20 ms	22.5 mm	Fixed	CE, UL Emergency Stop Devices LISTED, c UL LISTED
	**EM-FD-7G2** **EM-FD-7G3** **EM-FD-7G4**	24V ac/dc	1 Single Channel	4 @ 6 amps	.5 sec 1.0 sec 2.0 sec	22.5 mm	Fixed	CE, UL Emergency Stop Devices LISTED, c UL LISTED

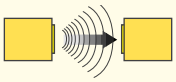
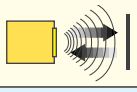
Safety Interlock Switch Selection Chart

www.bannerengineering.com/sg/safetyswitches

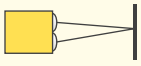
	Type	Family	Package Style	Housing Material	Protection Rating	Actuator Position	Actuator Types	Contact Options	Cable Entry	Solenoid Voltage
	Standard Mechanical	QS75 & QS90	Flat Pack	Plastic	IP 65; NEMA 4	Top, front & back	Straight, Flexible & Adjustable	1 N.C., 1 N.C./1 N.O., 2 N.C., 2 N.C./1 N.O.	Bottom & Sides	N/A
	Standard Mechanical	LS83 & LS100	Limit	Plastic	IP 65; NEMA 4	Top, front & back	Straight, Flexible & Adjustable	1 N.C./1 N.O., 2 N.C., 2 N.C./1 N.O.	Bottom	N/A
	Standard Mechanical	LM40 & LS40	Limit	Metal	IP 65; NEMA 4	Side, front & back	Straight & Flexible	1 N.C./1 N.O., 2 N.C.	Bottom	N/A
	Standard Mechanical	LS31	Limit	Plastic	IP 65; NEMA 4	N/A	Hinged,left, right and up, rotary	1 N.C./1 N.O., 2 N.C.	Bottom	N/A
	Guard Locking	LS42	Limit	Plastic	IP 65; NEMA 4	Top, side, front & back	Straight & Flexible	See page 218 & 219	Bottom & Sides	24V ac/dc or 24-48V dc & 24-230V ac
	Guard Locking	QM100	Limit	Metal	IP 67; NEMA 6	Side, front & back	Straight & Flexible	*1 N.C., 1 N.O./1 N.C., 1 N.O.	Bottom & Sides	24V ac/dc, or 120V ac, or 230V ac
	Magnetic	Mag 1 & 2	Rectangular	Plastic	IP 67 NEMA 4X	N/A	Coded Magnet	N/A	Standard & Cable Opposite (Mag 1 only)	N/A
	Magnetic	Mag 3	Cylindrical	Plastic	IP 67 NEMA 4X	N/A	Coded Magnet	N/A	Standard	N/A

A-GAGE™ Measuring Light Screens				
	Series	**MINI-ARRAY™**	**High-resolution MINI-ARRAY™**	**BEAM-ARRAY™**
	www.bannerengineering.com/sg	**/miniarray**	**/miniarray**	**/beamarray**
	Description	Compact array housings with flexible output configurations, long range.	High-speed, high resolution scanning with 2.5 mm (0.1") minimum object detection.	Rugged construction, separate controller not required.
Sensing Range	Opposed mode measuring light screens 	For arrays with 9.5 mm beam spacing: 6.1 m for ≤ 905 mm arrays 4.6 m for > 905 mm arrays For arrays with 19 mm beam spacing: 17 m for ≤ 905 mm arrays 14 m for > 905 mm arrays	1.8 m	3 m
Sensors	**Minimum object detection size**	19 mm for arrays with 9.5 mm beam spacing 38 mm for arrays with 19 mm beam spacing	2.5 mm	11.4 mm
	Dimensions	38.1 x 38.1 x height Approximate array heights: 140 mm 900 mm 290 mm 1050 mm 440 mm 1210 mm 600 mm 1510 mm 750 mm 1810 mm	38.1 x 38.1 x height Array heights: 163 mm 1138 mm 325 mm 1300 mm 488 mm 1463 mm 650 mm 1626 mm 813 mm 1788 mm 975 mm 1951 mm	58 mm dia. x height Array heights: 305 mm 915 mm 610 mm 1220 mm
	Construction	Black anodized aluminum	Black anodized aluminum	Black anodized aluminum
	Protection rating	IP65; NEMA 4	IP65; NEMA 4	IP66; NEMA 4
	Operating temperature	-20° to +70°C	0° to +50°C	0° to +50°C
	Power supply	12V dc supplied by controller	12V dc supplied by controller	15 to 20V dc (available from BC2A or BC2B controller)
Controllers	**Power supply**	MACNX DeviceNet MACPX DeviceNet	16 to 30V dc	**BC2A:** 105 to 125V ac **BC2B:** 210 to 250V ac **BC1T:** 15 to 20 V dc
	Output configuration	**MAC-1**: One reed relay + one NPN **MACN-1**: Two NPN **MAC16N-1**: 16 NPN **MACP-1**: Two PNP **MAC16P-1**: 16 PNP **MACV-1**: One 0-10V dc sourcing analog + one NPN **MACI-1**: One 4-20 mA sinking analog + one NPN **Serial RS-232** **RS-485**	**MAHCP-1**: Two PNP **MAHCN-1**: Two NPN **MAHCV-1**: Two 0-10V dc sourcing analog + one NPN **MAHCI-1**: Two 4-20 mA sinking analog + one NPN **Serial RS-232** **RS-485**	**BC2A** and **BC2B**: 4 discrete outputs: AC or DC, depending on I/O module selected; 2 analog outputs: 0 to 10V dc sourcing or 4 to 20 mA sinking; RS-232C; RS-422; and RS-485 serial data outputs **BC1T**: RS-232C serial data output
	Protection rating	IP 20; NEMA 1	IP 20; NEMA 1	IP 10; NEMA 1
	Operating temperature	-20° to +70°C	0° to +50°C	0° to +50°C

A-GAGE™ Part Sensing Light Screens			
Series	**PVA Series**	**LS Series**	**BMLV Series**
www.bannerengineering.com/sg	/pva	/ls	/bmlv
Description	Visible “pick” light & reliable error-proofing for assembly operations	Fast, reliable detection over a 90 mm (3.5”)	Retroreflective, self-contained light curtain
Sensing Range — Opposed mode part sensing light screens 	2 m	**LS4:** 2.3 mm **LS10:** 1.2 mm **LS10SR:** 0.2 mm	
Sensing Range — Retroreflective mode part sensing light screens 			3 m
Sensors — **Minimum object detection size**	35 mm	**LS4:** 25 mm **LS10:** 7.6 mm **LS10SR:** 5.6 mm	50 mm
Sensors — **Dimensions**	30 x 15 mm x height Array heights: 100 mm 300 mm 225 mm 375 mm	116 x 40 x 49 mm	58 mm x height Array heights: 305 mm 915 mm 610 mm 1220 mm
Sensors — **Construction**	Black anodized aluminum	PBT Polyester	Black anodized aluminum
Sensors — **Protection rating**	IP62; NEMA 2	IP54; NEMA 12	IP56; NEMA 4
Sensors — **Operating temperature**	0° to +50°C	0° to +50°C	0° to +50°C
Sensors — **Power supply**	12 to 30V dc	12 to 30V dc	10 to 30V dc
Controllers — **Output configuration**	One discrete NPN or PNP output, depending on model; 50 mA max.; programmable for light or dark operate	Bipolar NPN + PNP; 125 mA each output; dark operate Outputs have 5 ms pulse stretcher (OFF-delay)	One discrete Bi-modal™ output: NPN or PNP, depending on hookup; 200 mA max.; light or dark operate
Controllers — **Connections**	Integral 2 m cable with or without quick-disconnect	**LS4**: Integral cable or quick-disconnect **LS10 & LS10SR**: Quick-disconnect	Quick-disconnect.

U-GAGE™ Ultrasonic Sensors	Ultrasonic Sensors			
				
Series	**T18U**	**T30U**	**Q45UR**	
www.bannerengineering.com/sg	/t18u	/t30u	/q45u	
Opposed-mode 	0.6 m			
Proximity mode 		0.15 to 1 m 0.3 to 2 m	0.5 to 0.25 m	
Dimensions (h x w x d)	52 x 40 x 30 mm	52 x 40 x 45 mm	M18 x 1 x 45 mm 28 x 28 x 12 mm	
Housing material	PBT polyester	PBT polyester	s.steel (M18 sensor) PBT Polyester (all others)	
Protection rating	IP67; NEMA 6P	IP67; NEMA 6P	IP67; NEMA 6P (controller) IP65; NEMA 4 (sensor)	
Operating temperature	-40° to +70°C	-20° to +70°C	-25° to +70°C	
Power supply: V dc	12 to 30	12 to 24 (discrete/ analog current) 15 to 24 (analog voltage)	12 to 24 (discrete) 15 to 24 (analog)	
V ac (50/60 Hz)				
V ac/dc				
Output: NPN (sinking)	150 mA	100 mA		
PNP (sourcing)	150 mA	100 mA		
NPN + PNP			Bipolar, 150 mA	
SCR or FET				
E/M relay				
Analog		0 to 10V dc or 4 to 20 mA	0 to 10V dc or 4 to 20 mA	
Connections: Cable	✓	✓	✓	
Quick-disconnect (QD)	✓	✓	✓	
Wiring chamber				
Teach-mode programming		✓	✓	
Windowing		✓	✓	
High/low limit control				

Ultrasonic Sensors			
			
	Q45U	**OMNI-BEAM™**	**ULTRA-BEAM™**
	/q45u	/sonicomni	/ultrabeam
	0.1 to 1.4 m 0.25 to 3.0 m	0.1 to 0.66 m	0.5 to 6 m
	88 x 45 x 55 or 79 mm	111 X 45 X 74 mm	120 x 50 x 49 mm
	PBT polyester	PBT polyester	PBT polyester
	IP67; NEMA 6P	IP66; NEMA 4	IP54; NEMA 12
	-40° to +70°C	0° to +50°C	0° to +50°C
	12 to 24 (discrete) 15 to 24 (analog)	18 to 30 (discrete) 15 to 30 (analog)	18 to 30 (analog)
		105 to 130 or 210 to 250	105 to 130 or 210 to 260
	Bipolar, 150 mA		
		7 A	5 A
	0 to 10V dc or 4 to 20 mA	0 to 10V dc	0 to 10V dc or 4 to 20 mA
	✓	✓	✓
	✓	✓	✓
	✓		
	✓	✓	✓ (analog)
	✓	✓	

L-GAGE® Light Gauging Sensors				
Series	**LG Series**	**PD Series PicoDot®**	**QM Series Adjustable-Field Sensors**	**Q50**
www.bannerengineering.com/sg	/lg	/picodot	/qmaf	/q50
Description	Ultra-precise laser triangulation sensor with both analog and discrete outputs	Compact laser triangulation sensor for precise part detection	LED-based distance sensors with single switchpoint	LED-based linear displacement sensors
Technology	Laser/PSD triangulation	Laser/dual PD triangulation	LED/PSD triangulation	LED/PSD triangulation
Sensing Range 	Programmable sensing window: **LG5:** 45 to 60 mm **LG10:** 75 to 125 mm	**PD50:** 10 to 55 mm **PD100:** 10 to 110 mm **PD200:** 5 to 220 mm	**QM150:** 5 to 150 mm **QMT400:** 25 to 400 mm **QM150:** 50 to 150 mm **QMT400:** 125 to 400 mm	**Q50BV:** 100 to 300 mm **Q50B:** 100 to 400 mm
Light Source	Class II Laser	Class II Laser	Visible red LED	Visible red or infrared LED
Dimensions	55 x 20 x 82 mm	41 x 13 x 46 mm	**QM150:** 42 x 13 x 42 mm **QMT400:** 58 x 18 x 42 mm	50 x 15 x 60 mm
Housing material	Zinc alloy die-cast; black painted finish	Black Cycolac® ABS	Zinc alloy die-cast; black painted finish	ABS/Polycarbonate
Protection rating	IP67, NEMA 6	IP54, NEMA 3	IP67, NEMA 6	IP67, NEMA 6P
Operating temperature	-10° to +50°C	-10° to +45°C	-20° to +55°C	-10° to +55°C
Power supply	12 to 30V dc	10 to 30V dc	10 to 30V dc	12 to 30V dc (discrete) 15 to 30V dc (analog)
Discrete output(s)	One NPN or PNP (100 mA max.)	Complementary NPN or PNP (100 mA max.)	Complementary NPN or PNP (100 mA max.)	Complementary NPN or PNP, 0 to 10V dc or 4 to 20 mA (depending on model)
Analog output	0 to 10V dc or 4 to 20 mA	None	None	
Analog resolution or discrete repeatability	**LG5:** 3 µm @ 50 mm **LG10:** 10 µm @ 100 mm	N/A	**QM150:** 0.5 mm @ 100 mm **QMT400:** 1.5 mm @ 250 mm	0.5 mm @ 200 mm
Response speed	1 ms (fast) 10 ms (medium) 100 ms (slow)	200 µs	1 ms	4 ms (fast) 64 ms (slow)
Adjustments	Near and far window limits; response speed	12-turn sensitivity (Gain) adjustment	12-turn switchpoint adjustment	Near and far window limits; response speed

*Presence*PLUS™: Banner takes optical sensing to the next level.

An easy-to-use pixel-counting sensor.

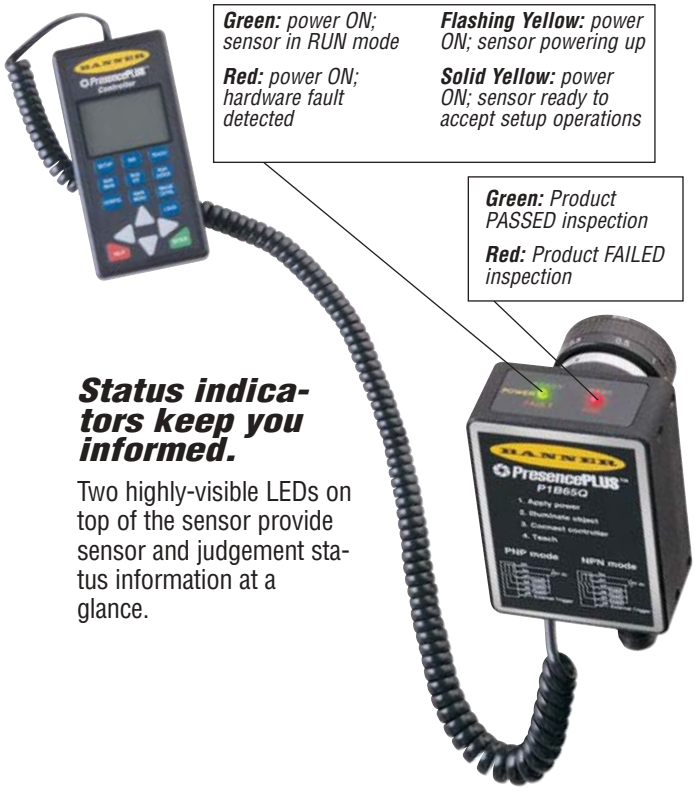
PresencePLUS™ is the world's most user-friendly camera-based sensor. It can economically solve your inspection applications as a simpler alternative to vision systems or
by eliminating the need for multiple discrete sensor configurations that are often mechanically impractical.

Accurate, reliable inspection of a defined area of interest.

The PresencePLUS sensor is an advanced inspection system that captures a 256-level gray-scale image of a defined area, converts the image to white and black pixels, and renders a PASS or FAIL judgement of the image by comparing the number of pixels to a reference count.

Advanced, microprocessor-based sensing functions at a price you can afford.

The PresencePLUS system offers both QUICK START setup for basic applications, and user-programmable functions to solve your more exacting applications, for an exceptionally low price. A PresencePLUS sensor starts at under $1000, and you can order a complete system, consisting of a CMOS pixel array with programmable microprocessor, lens, lighting, mounting bracket and cable, for under $1600.



Status indicators keep you informed.

Two highly-visible LEDs on top of the sensor provide sensor and judgement status information at a glance.

Plug into any Windows PC serial port for easy setup.

The PresencePLUS2 sensor connects to any standard serial port on a PC running Windows 95, 98 or NT. User-friendly graphics make setup fast and easy. The PresencePLUS2 includes three easy-to-navigate windows making the sensor extremely easy to setup and maintain.

Or use the convenient PresencePLUS handheld controller.

PresencePLUS setup programming can also be accomplished using the PRC1; a convenient hand-held, remote controller that attaches to the sensor with a coiled cord. The PRC1 features a built-in LCD screen that displays programming options, monitoring options, compressed captured images, and diagnostics during sensor operation. A single hand-held controller can set up multiple sensors.

Visit www.bannerengineering.com/sg/presenceplus

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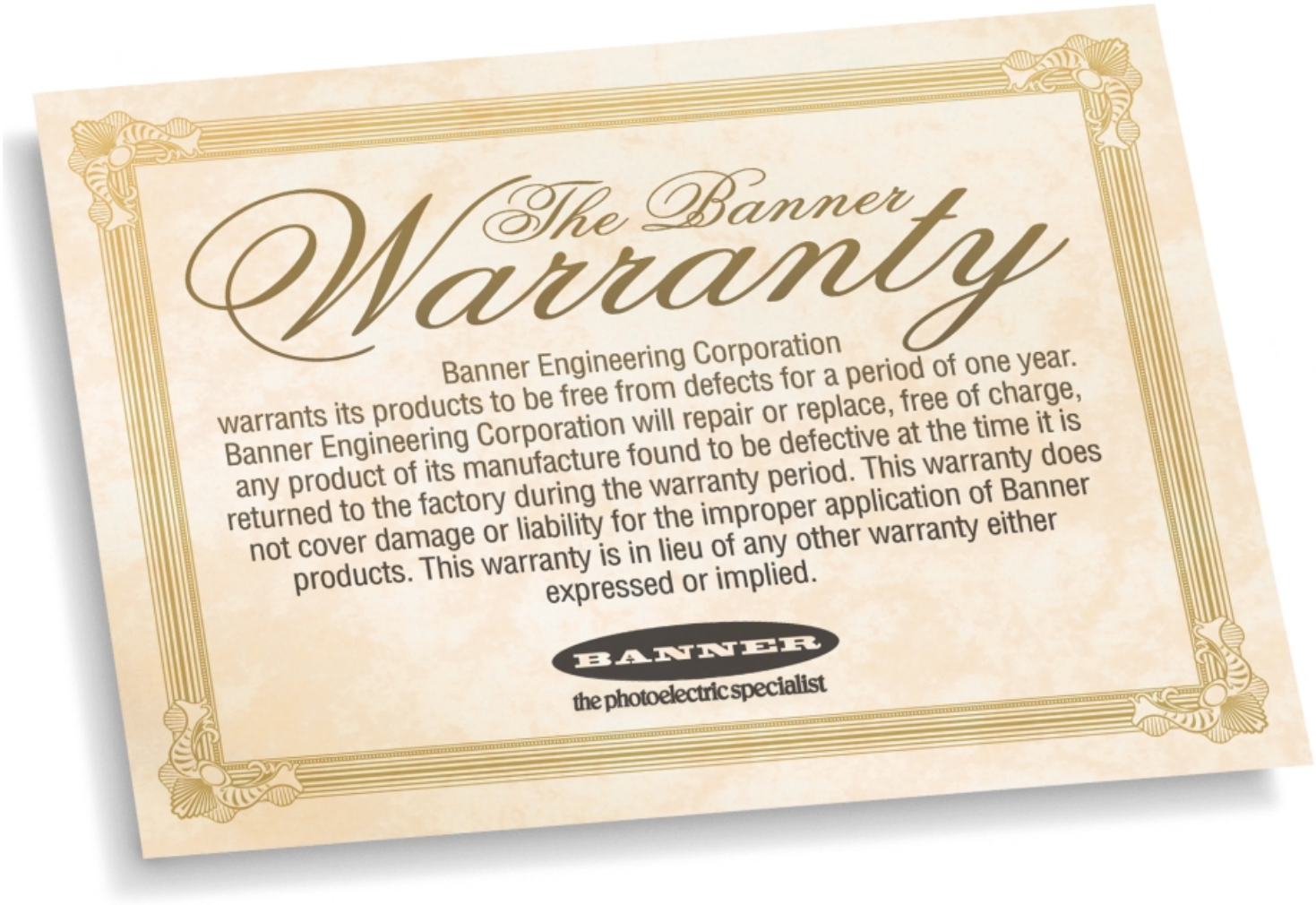

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